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ON THE COVER

As he zips around Earth at 17,000 mph, astronaut William Fisher works on a communications satellite in the Space Shuttle cargo bay. To get the job done right the first time, astronauts need specially designed equipment. Read about how today's Shuttle crews are working miracles in space in the exciting story on page 103.

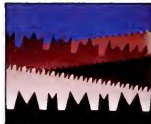
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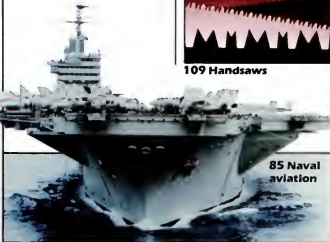
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Sometimes, things just don't work out—as Henry Ford II reminded Lee Iacocca on the occasion of Iacocca's firing from Ford Motor Co. That seems to be the case with us and the Bonneville Salt Flats. For the past two years, we've been trying to set some land speed records at Bonneville and it just hasn't worked out. Two years ago, we tried the high-tech approach with a Buick Skyhawk outfitted with a 4-cylinder engine, twin turbochargers, waste gates, experimental fuel injection and the whole nine yards. The engine puked its guts on every run. Last year, we decided that the way to go was the old hot-rod approach, forsaking turbos and fuel injection for cams and carburetors. On the way to Wendover, Utah, from Los Angeles with the record-attempting Buick Skyhawk in tow, our crew ran into the most severe windstorm in decades. The wind flipped our trailer and wrecked the car inside.



Before the flip: PM crew packs Skyhawk for Bonneville.

So, perhaps you can understand why we've decided against a third attempt at setting any records at Bonneville. It's too dead there, anyway. Does anyone know if it's possible to set any car speed records in, say Cancun? . . . We've all heard the news reports. The anchor says something to the effect that Shuttle astronauts today made several repairs to a satellite in orbit around the Earth, restoring it to full function. I've always wondered what exactly you have to do to a satellite to fix it while floating weightless hundreds of miles above the surface of the Earth. And what kind of tools do you use in outer space? Our cover story this month (page 103) answers these fascinating questions and more. Check it out. . . . I've often said we'd go anywhere for a story and, while Japan isn't the farthest point on the face of the Earth, it's pretty far to go for one article. Yet, that's where West Coast Editor Steve Parker went last fall to bring you the story in this issue on the new 4-wheel-steering cars

being developed by several Japanese automakers (page 94). Nissan, Mazda and Toyota have 4ws systems under study and Parker examined them all on his visit to the Tokyo Motor Show. Not only did he get the story, he got to drive Toyota's experimental FXV with 4-wheel steering. My question is, is the concept ahead of its time? Or, like sushi, is it an idea whose time has come? Til next time.



Parker checks 4-wheel-steering Toyota.

Joe Oldham



Small Wonder

It's here, *pocket-size* radar protection.

Imagine a superbly crafted electronic instrument, powerful enough to protect against traffic radar, miniaturized enough to slide into a shirt pocket, beautiful enough to win an international design award.

Small means nearly-invisible protection

That could only be PASSPORT. It has exactly what the discerning driver needs, superheterodyne performance in a package the size of a cassette tape.

This miniaturization is possible only with SMDs (Surface Mounted Devices), micro-electronics common in satellites but unprecedented in radar detectors. It's no surprise that such a superlative design should be greeted by superlatives from the experts.

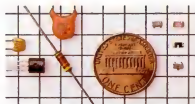
"In a word, the Passport is a winner," said *Car and Driver*.

The experts report excellent performance. Simply switch PASSPORT on and adjust the volume knob. Upon radar contact, the alert lamp glows and the variable-pulse audio

Small means the size of a cassette tape

begins a slow warning: "beep" for X band radar, "brap" for K band. Simultaneously a bar graph of Hewlett-Packard LEDs shows radar proximity.

As you get closer, the pulse quickens and the bar graph lengthens. Should you want to defeat the audible warning during a long radar encounter, a special switch provides silence, yet leaves PASSPORT fully armed for the next encounter. A photocell adjusts alert lamp brightness to the light level in your car. PASSPORT was designed for your protection *and* your convenience.



In PASSPORT, 102 SMDs (right) do the work of ordinary transistors, resistors and capacitors.

PASSPORT comes with a leather case and travels like a pro, in your briefcase or in your pocket—to the job for trips in the company car, on airplanes for use in far-away rentals. Just install on dashtop or visor, then plug into the lighter. PASSPORT keeps such a low profile. It can be on duty without anyone noticing.

Small means an easy fit in the briefcase

One more PASSPORT convenience—call us direct. It's toll free. We make PASSPORT in our own factory and we'll be happy to answer any questions you may have. If you decide to buy, we'll ship your PASSPORT within 24 hours by UPS, and we'll pay the shipping. For an extra \$6.00, Federal Express guarantees 48-hour delivery.

If you're not satisfied within 30 days, return PASSPORT. We'll refund your purchase and your return shipping costs. There are no hidden charges.

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THESE MEN KNOW EXACTLY what's happening inside every barrel in a Jack Daniel's warehouse.

In the heat of summer the whiskey is expanding into the charred inner wood of the barrel. Come Halloween, it's starting to cool. And inching its way back toward the center. Over the aging period, this gentle circulation of whiskey is going on constantly. Of course, it can't be perceived by the human eye. But after your first smooth sip of Jack Daniel's, we believe you'll recognize its importance.



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Letters



Logging beats jogging



Reader Fabrizio quick-split 10 cords of wood with PM's splitter.

I built your woodsplitter (PM's Back-Saving Log Splitter Lets You Split A Cord Of Wood In 2 Hours, page 142, Oct. '78) with a change in engine size from 3½ to 7½ hp. I split 10 cords of wood in about 3 hours.

RICHARD FABRIZI
GRAND ISLAND, NY

Okay, now let's stack that wood neatly! Other readers who want to harness their energy and stay fit without running around in circles can build one of PM's many projects. They're described in our Plans and Ideas brochure. The brochure is available by sending a check or money order for \$1.50 to Popular Mechanics, Box 1014, Radio City Station, New York, NY 10101.

Gimme a Jimmy

I read Japanese Micro-Mini Cars—Cars You Can't Get Here (page 89, July '85) and want to let you know I've had one since July 1984. My Suzuki Jimmy SJ is a 410LC model with 970-cc, 45-hp engine. It's a 4-cylinder, 4-stroke, water-cooled, ohc de-

sign. So far I have 19,000 miles on it. I get 30 mpg and can go just about anywhere in 2wd. I only have to use 4wd occasionally. The only problem I've had with the car was a separation of the weld between the catalytic converter exhaust pipe going to the manifold. It's a super vehicle for the \$6800 that I paid for it.

EDWARD BOHNE
LAKE PARK, FL

We should have mentioned in our July '85 story that some limited marketing of the Jimmy did take place here. For an up-to-date run-down on Suzuki's models for the U.S., see Invasion Of The Microcars in this issue starting on page 95.



Bohne family has one of the first Suzuki Jimmys available here.

Hello, Dolly!

Here's a photo of the tool dolly that I built using the illustration and instructions in your story Build PM's Tool Dolly (page 132, Oct. '82). However, I changed some dimensions and added some features to suit my needs—like a pipe coupling so the dolly can be disassembled for portability. I also added carpeting on the upright so it won't scratch my truck. When I saw your article, I thought the dolly would be useful, and it sure has been!

TONY SIMON
GENOA, OH

Nice job, Tony. Readers who wish photocopies of the tool dolly story can send a check or money order for \$1.50 to Popular Mechanics, Box 1014, Radio City Station, New York, NY 10101.

Build a car

I had an interest in kit cars for several years and even bought one manufacturer's assembly manual. It was so sad I lost interest. Then, your article (The Real Fun Of Building A Kit Car Is



Reader Simon's dolly nestles up to his engine compartment.

ducing a great kit car and putting fun back into driving. LAWRENCE E. SMITH
GREAT BEND, KS

Thank Blakely Auto Works for the Bernardi. It's their brainchild and they're still selling it.

In addition they now make a kit car called the Hawk. Blakely's is at 124B Fulton St., Princeton, WI 54968.



Bernardi kit car built by reader Smith has crisscrossed the Midwest.

Driving It When It's Finished! page 96, Oct. '81) introduced me to the Bernardi. Within eight months I was driving my own Bernardi. I used a '74 Mustang II with a 2800-cc V6 and automatic transmission for my donor car. And you were right—the real fun began when it was finished.

We now have over 15,000 miles registered on the odometer. The driving I've logged includes a trip back to the factory in Princeton, Wisconsin, to Texas last February and to the Kit Car Nationals in Detroit last July.

Thanks to PM for intro-

The right height

I just finished construction of your 3-position table (Weekend Workshop: 5 Tables For A Movable Feast, page 102, June '85). But, the dimensions given on the drawing for the inset from the edge of the table for parts C and D (9") did not work out to give the specified table height for the low and medium positions. The inset measurements for C and D had to be altered to 7½ and 7 inches, respectively.

STAN HECHINGER
LOS ANGELES, CA

Your numbers are right, Stan. Thanks. PM



Welcome to the Age of Aerostar.

Ford announces a new mini-van with the biggest payload* and the highest gas mileage rating in its class! **

Once again, Ford moves ahead in van design. Introducing Aerostar—a new concept in business efficiency.

Most aerodynamic van.

Aerostar's advantages start with its sleek, wind-splitting design. Low drag coefficient of .37 makes it the most aerodynamic van in America. And the resulting good looks are good for any business.

High-MPG Four or husky V-6 power.

For maximum mileage, choose Aerostar's advanced Four with multiport electronic fuel injection. Its EPA estimates of 26 city MPG, 29 highway MPG are the best of any mini-van.*

For extra power and response, choose the optional 2.3L V-6. The V-6 is bigger and stronger. But like the Ford, it's a modern computer-controlled engine.

Biggest payload.

The truck-tough Aerostar can shoulder over a ton* of payload—the most of any



mini-van. There's plenty of space to put the load in, too. Cargo floor behind the seats is over 7 ft. long.

Flat, low-lift floor.

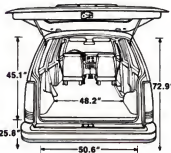
The rear liftgate swings up out of the way, so you can step right up to the level cargo floor for easy loading. Ground-to-floor lift is only 25.8 in.

Tows 2½ tons.

Here's another measure of this Ford's capability. Because of its high strength, rear-wheel drive and optional V-6 power, Aerostar can be equipped to tow 5,000 lbs.

That's 2½ times more than front-drive vans!†

Whether you're towing or hauling, the added weight is on the rear driving wheels where it needs to be for full traction.



Longest wheelbase, shortest outside length. Aerostar's 119-in. wheelbase is the longest of any mini-van for a smooth ride.

But it's the shortest van overall and very maneuverable. Turning diameter is 3½ ft. smaller than the Dodge Mini Ram van.

Easy to get into, to handle, to drive.

Aerostar makes everything you do easy to do. Doors are high, wide, easy to open. The step to the driver's seat is low, but you sit tall with a commanding view of the road ahead. Steering, manual or power, is quick rack-and-pinion.

Garage it anywhere.

The maneuverable Aerostar parks with minimum space and effort. It's sized to go in virtually any standard garage or through the car wash.

Built Ford Tough.

Ford took the time to make Aerostar right the first time. Built to pass the same durability standards as big Econoline vans, it's already had over a million miles of accelerated testing. Now it's ready for you.

Lifetime

Service Guarantee.

Participating Ford Dealers stand behind their work, in writing, with a free Lifetime Service Guarantee for as long as you own your Ford car or light truck. Ask to see this guarantee when you visit your participating Ford Dealer.

Buckle up—
together we can save lives.

How the Mini-vans Compare

	FORD AEROSTAR	DODGE MINI-RAM VAN
Aerodynamic for lower air drag	.37	.42
Standard 4-cyl. engine	2.3L	2.2L
Electronic fuel injection	YES	NO
V-6 engine option	YES	NO
Maximum towing†	5000 lbs.	2000 lbs.
Maximum cargo volume cu. ft.††	140.3	133.0
Longer wheelbase, smooth ride	119 in.	112 in.
Short turning diameter	37.5 ft.	41.0 ft.

*With optional payload package. **EPA estimates 26 city MPG; 29 highway MPG equipped with 2.3L Four EPA and standard 5-speed manual transmission. †Reduced by passenger and cargo wt. in towing vehicle. ††Based on SAE-J100 Code V-6.



Imports

BY BILL HARTFORD

Thoroughly modern MG



It's a tease to be sure, but this concept-car MG, put together by the Austin Rover Group in England, could become a production car in the 1990s. The EX-E couldn't be farther from the flapping side curtain MGs that came out of the Morris Garages. The MG could now stand for modular and glued up. Three main modules go together with the high-strength, aluminum-alloy frame: one car-

ried the rear engine and suspension, another the passenger compartment and the third the front suspension, steering and final drive systems. Adhesive bonding of the plastic skin panels completes final assembly.



The test-bed vehicle is powered by Austin Rover's 3-liter V6, a 4-valve-per-cylinder aluminum unit tuned for 250 hp. The engine and 4wd components were devel-

oped for the Group B MG Metro 6R4 rally car. The slippery body has a drag coefficient of 0.24 and the roof is the canopy-type most often seen on jet fighter aircraft. Inside, a credit-card-type key is for locks and ignition, rain sensors in the windshield activate the wipers, and other instrumentation and displays—like navigational aids—take full advantage of the central computer. This car wants to take you into the future. Are you ready?



Slippery body is made up of plastic panels bonded to modules. Rear engine is Austin Rover's 3-liter V6 tuned for 250 hp.



Nissan pickup for '86 1/2 had its sloping hood and raked windshield designed in California. Power for the SE is from a big 3-liter V6.

oped for the Group B MG Metro 6R4 rally car. The slippery body has a drag coefficient of 0.24 and the roof is the canopy-type most often seen on jet fighter aircraft. Inside, a credit-card-type key is for locks and ignition, rain sensors in the windshield activate the wipers, and other instrumentation and displays—like navigational aids—take full advantage of the central computer. This car wants to take you into the future. Are you ready?

Nissan hotbed

Only Big Foot has more power. The 140 hp that lets Nissan's 1986 1/2 pickup roll over the competition comes from a 3-liter V6, the largest displacement and only V6 that's available in a compact pickup. The "Power" package offered in SE models also includes power windows, door locks and mirrors. Four SE models—4x2 and 4x4 Regular Beds and King Cabs—are the hot setups among the 14 models in the new pickup line. Standard, E and XE trucks come with Nissan's 2.4-liter NAPS-Z Four which, like the V6, is fuel injected. Five-speed transmissions are standard in the '86 1/2s, and a new 4-speed automatic is optional in the 2wd models. The Regular Beds (72.6-in.-long cargo beds) are on a 104.3-in. wheelbase, Long Beds (88.0 in.) and King Cabs (73.4 in.) are on a 116.1-in. wb. Cargo

beds are of double-wall construction and are a deep 17.1 in. Pop-up tie-down hooks are an innovation.

And, as you may have realized from the photo above, this is one good looking truck. The hood slopes noticeably and the raked windshield increases interior room and aerodynamic efficiency. The design comes from Nissan Design International in La Jolla, California. President of the center, Kazumi Yotsumoto, designed Nissan's first pickup truck back in 1958.



President of the La Jolla design center, Kazumi Yotsumoto, and his 1960 Nissan pickup.

Not imported here

I seem to remember this car. It just had its 50th anniversary. Yes, it's still made—in Brazil, Mexico and Nigeria. The current model looks



Anniversary whatchamacallit.

pretty much like the one that was last sold here in 1977 (a convertible was available 'til '79). Big change for the anniversary edition is the "50" badge just under the base of the radio antenna. What the devil was this car? You know, they always had a chain through the hood handle and locked around the front bumper.

FM

Come to Marlboro Country.

Marlboro Red or 100's -
you get a lot to like.

Marlboro
100's

Marlboro
100's

SURGEON GENERAL'S WARNING: Smoking Causes Lung Cancer, Heart Disease, Emphysema, And May Complicate Pregnancy.

16 mg "tar," 1.0 mg nicotine av. per cigarette, FTC Report Feb '85

Aviation

BY DENNIS ESKOW



Plastic fantastic fighter



Full-scale model of World War II fighter, Spitfire Mark IX, sits in front of the Imperial War Museum in England. The plane is plastic.

The first plastic model I ever built was a World War II Spitfire fighter. It was a faithful 1/16 scale you doped together. But the age of plastic models has advanced since then, and now the Imperial War Museum in Duxford, England, is showing off a full-scale model of the Spitfire Mark IX. It's made of glass-reinforced plastic from molds taken from the actual aircraft, so the model is faithful down to every rivet. Specialized Mouldings of England is making copies of this fighter for several museums and will build one for anybody at about the cost of a used Spitfire—if you can find a real Spitfire.

Flash flies

The European "microlight" aircraft business got a boost late last year when the British Civil Aviation Authority approved the Flash for flight. The 2-seater is powered by a 440-cc engine. It folds for traveling. Flash is made by Mainair Sports Ltd. of Lancashire, England. The microlight flier sells for just under \$7000 in kit form.



The microlight Flash is a folding 2-seat kit plane with power.



The Panther 2 Plus uses new airfoil design to mimic fighters.

Fuel de-icer

PPG Industries has introduced a new fuel de-icing additive. Prist Lo-Flo is available in an 8-ounce aerosol container that will regulate delivery of the de-icer precisely.

Primary aircraft

We opened discussion in this space last month on federal proposals to make it easier to get a pilot's license. Just about everyone in the aviation industry has a bone to pick with that proposal. But another federal proposal—to create a new licensing procedure (like auto registration) for light aircraft—is meeting with more favorable reception than the aforementioned regulatory proposition.

The proposal, backed by the Aircraft Owners and Pilots Assn. (AOPA) and by the Experimental Aircraft Assn. (EAA), essentially would bring ultralights into the category of licensed aircraft. At present, you don't need a license to fly an ultralight. That's a selling point for some buyers. But it is something that is disturbing to the general aviation industry. Sport planes, crop dusters and kit planes of all kinds would fall under the aegis of the new license if it is adopted.

Panther pounces

One of the most popular experimental kit planes shown at Oshkosh's big Air Show of 1985 was the Rotec Panther 2 Plus. It is now available with an electric starter and full-span ailerons. The ailerons and a balanced rudder give the 2-place Panther a lot of flight maneuverability. In fact, the plane represents a whole new airfoil design that makes it possible to land safely in 20-mph crosswinds. In test flights, the Panther 2 Plus completed controlled S turns down the runway on one wheel.

In flight, the Panther can be slipped smoothly to the right or left with no abrupt changes in sideslip angle, pitch, roll or yaw. Basically, the plane rolls like a military fighter. The Panther 2 Plus costs \$7900 from Rotec Engineering of Duncanville, Texas.

One-piece flight

Coming soon at most of your Ultralight Aircraft dealers will be a single-seat, "joined-wing" aircraft. The joined wing arranges the ultralight's wings to form a diamond shape in plan view and front view. The two wings become one joined unit with higher stiffness and lighter weight than on planes with traditional wing layouts.

The first company expected to go commercial with this design is Summit of Denton, Texas. The company's Trident airplane will be sold as a kit with an engine and pre-molded fuselage and wings. No glues or epoxies will be needed to finish the kit. NASA, the Navy and several universities have explored the joined-wing field for more than a decade. So far, Trident is the only one expected to go commercial. **PM**

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903



612



906



904



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614



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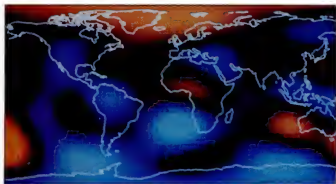
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Science

BY DENNIS ESKOW



Remaking a world map



Map shows Earth's hotter regions (orange) 60 miles below surface.

Satellites have helped us change the world map's contours and dimensions slightly over the past 30 years. But computers connected to both satellites and seismographs (the sensors that detect earthquakes) are revealing a new kind of map picture.

It's called seismic tomography, and it presents a picture of the Earth's temperature 60 miles beneath the surface. The orange regions are hotter and the blue regions cooler. Seismic tomography is helping scientists around the world discover new potential earthquake sources as well as new sources of oil and other products.

You can see more of these images on the Public Broadcasting System's new series "Planet Earth." The TV show is an exciting report on the very latest developments in earth science and the technologies used to explore it.

Earth drift shift

The Earth's magnetic field is little understood by geophysicists. But all of the scientists agree that it is related to the flow of liquid metals in the hot core beneath the Earth's surface. Geophysicists also know that the Earth's magnetic field is drifting westward about 1" every five years, or about 12 arc minutes per year.

Data reported in a recent issue of *Science News* now suggest that there were

sharp jerks in the magnetic drift in 1969. That is, the drift exceeded 12 arc minutes by a tad that year, then went back to 12 arc minutes in 1970. A similar jerk seems to have been recorded in 1912. The scientific community is puzzled by the jerks in the magnetic drift. But researchers now believe there is a bubble in the Earth's liquid core and the changes in the flow of magnetism happen when it comes to the surface periodically.

Shuttle prep

As I prepare myself for candidacy to be the first journalist on the Space Shuttle, I'm learning a great deal about getting into shape. I'll be sharing some hot tips with you in the next few months. At this writing, I have lost over 30 pounds without having to change my dietary habits much.

I've been following the advice of researchers who believe in the "set point" theory. It simply states that the human body adjusts to a certain caloric intake each day. The amount of calories your body is used to having to maintain itself is the set point. If you want to lose weight, you will have to adjust your set point. That can be accomplished by depriving the body of calories, or by increasing the body's caloric requirements through exercise.

The problem with dieting, warns Dr. Mel Hoerner of Sports Medicine Associates in New York, is that it may trick the body to your detriment. "If the body is used to a daily intake of 3000 calories and you suddenly go down to 1500 calories, the body will consider itself under attack," Hoerner explains.

The results may be the conversion of muscle tissue into fat to produce emergency calories. Dr. Hoerner and others suggest exercise is the best way to begin attacking the problem. Exercise on a moderate level burns off calories, a function not read as a danger sign by the body.

A daily half-hour walk burns off at least 350 or so calories. Then, if you don't eat any more than you usually do, you can lose about 2 pounds per week just by taking daily brisk strolls.

I've been working out on a swimming, weightlifting and moderate calisthenic program for over three months. Now, I'll begin dieting moderately so as to augment what the exercise program is doing for me: adjusting the set point so my body burns more calories each day. Stay tuned for exercise tips for the overweight.

Galactic question

The central region of our own galaxy, the Milky Way, is a hotbed of strange activities. It has long been suggested that a black hole rests at the center of the Milky Way. But radio telescope investigations now suggest there is an energetic "jet" of matter coming from the same region.

Is the black hole sucking in star dust? Or is there a magnetic source of some kind at the galactic core? Scientists at the University of California and Columbia University are looking at radio photos of the core. We'll let you know when they have an answer.

Fusion vision

Fusion reactors of the 21st century are expected to supply a large percentage of America's energy. The reactors will generate a lot of heat, and it's expected that liquid metals such as lithium will be used as coolant. Fusion reactors work by combining the nuclei of simple atoms to form energy and new heavy atoms. To do it, they need large magnets. Will the magnets disturb the metallic coolant? The question is now being explored at Argonne National Laboratory. Its new liquid metal experiment chamber has begun a search for the best coolant candidate.

PM



Argonne National Laboratory's new liquid metal facility seeks a fusion reactor coolant.

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Outdoors

BY TIM COLE

Honda's new ATV 4x4



Honda's 4-wheel-drive ATV is a nimble, powerful newcomer.

All ATVs are ingrained with a bit of the proverbial mountain goat. But Honda's new 4x4 Fourtrax puts a whole

new dimension on 4-wheel fun. Its continuous 4-wheel drive is delivered through a dual-shaft system from a beefy 350-cc powerplant. With 5-speed transmission and reverse, the Fourtrax is designed to get you into—and out of—places where other ATVs fear to tread. The Fourtrax touts several maintenance-free systems, including a limited-slip front differential, solid-state ignition and 12-volt battery—all designed to keep you riding longer. The Fourtrax' leading arm and trailing arm suspension means you won't give out on treads. With its pack-mule personality, it's easy to see why Honda's \$3000 entry in the ATV field makes sense. For more information, contact your Honda dealer.

Solar-powered diving gear

The Solar Snorkel, sends a clean supply of compressed air down a 35-foot flexible plastic hose. Its compressor is powered by a 6-volt dry gel/cell battery, which is recharged by a photovoltaic solar panel. If the weather turns cloudy, battery power is more than enough to keep you breathing, as I discovered during a check dive with the snorkel's designer. All components float on a 2-part foam platform, which folds for easy storage. The snorkel would be great for reef diving or other near-

surface activity. It's available for \$910 from Harry Miller, RD 3, Box 225, Trumansburg, NY 14886.

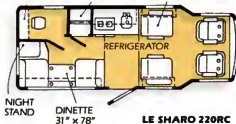


Drive systems of Solar Snorkel rest on 2-part foam platform that folds for storage.



The popular Winnebago Le Sharo has a whole new look for privacy inside.

ENCLOSED LAVATORY WARDROBE COMPANION SEATS 42" x 74"



LE SHARO 220RC

The Le Sharo's new look

The down-sized Le Sharo has become a mainstay at Winnebago. Recently, the company sensed that older couples out for more lengthy excursions might be drawn to the Le Sharo's manageable, fuel-efficient package. An accommodation change was called for that streamlined the interior and highlighted privacy. The result is the 220 RC, the principal feature of which is a separate enclosed bathroom on the

left rear quarter, which replaces the clever though cumbersome slide-out bathroom on the original design. The after dinette/double bed combination is replaced by a slightly narrower arrangement running longitudinally along the right rear. The 220RC's galley runs fore and aft along the left side. This good idea just keeps getting better. For information, contact Winnebago Industries, Forest City, IA 50436.

Tilt/trim retrofit

There's no question that the trim/tilt function on outboard power adds considerably to speed and fuel efficiency for any size engine. But up to now, trim/tilt has only been available on larger outboards. Now, Sween Marine has introduced a trim/tilt package for smaller engines that bolts directly to the transom. The unit consists of two electrically driven rams that operate incrementally for trimming under way and at full boost if you want to tilt your engine out of harm's way on a beach approach. Sween claims its trim/tilt motor will cut fuel consumption by 20 percent at planing speeds, increase top-end performance and save gallons of fuel each season. Now



Trim/tilt is now available for smaller outboard powerplants.

you can maintain proper cruising speeds at lower power settings, and can mount the \$688 unit in less than an hour. For more information, contact Sween Marine at P.O. Box 980, Lake Crystal, MN 56055.

(Please turn to page 21)

Boating... The Affordable Adventure!



*C'mon
Aboard!*



There's Never Been A Better Time To Live The Boating Adventure...

C'mon, admit it.

Owning a boat has been a dream since you can remember. But, you've always put it off. You watched from the shore. You thought a boat was a little bit out of reach.

Not any more.

The current mix of a favorable economic climate, abundant financing opportunities, wide selection, and special incentive programs, make now the best time ever to buy a boat.

Now's the best time to live the adventure of early morning fishing on a pristine mountain lake...skiing over mirror smooth water...sailing along a secluded harbor with the

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Boats have never been better built, easier to operate, or a better value. And all you have to do is...C'mon Aboard!

Boating's Never Been A Better Bargain!

What does it cost to live the adventure? Not as much as you may think.

Today, financing your boat is as simple as financing your family car. Financing is more readily available and more competitive than ever before. You can obtain financing through your dealer, your bank, or through a specialized marine lender.

Boats are good investments. Unlike most cars that start losing their value as soon as you drive them off the lot, boats hold their value and offer great resale potential. A well-maintained boat can often sell for between 80 and 100% of its original cost.

Talk to your local dealer, he can help you find attractive financing plans in your area.



Boating Is Affordable!

\$499 total*

16 FT. ALUMINUM CANOE

(*Approximate total cost based on manufacturers' average prices.)

\$183 per month

19 FT. RUNABOUT w/170 HP INBOARD/OUTBOARD

(Based on 20% down at 13.5% interest per year over 7 years.)

Approximate cost: \$12,395.00

\$124 per month

24 FT. PONTON BOAT w/35 HP OUTBOARD

(Based on 20% down at 13.5% interest per year over 5 years.)

Approximate cost: \$6,733.00

\$110 per month

16 FT. ALUMINUM FISHING BOAT w/50 HP OUTBOARD

(Based on 20% down at 13.5% interest per year over 5 years.)

Approximate cost: \$5,990.00





Boats Are Easier To Own And Operate Than Ever Before!

Today's boats are designed to provide years of safe family fun. Advances in design, materials, and technology make today's boats longer lasting, easier to operate, and easier to maintain. And, there's a wider variety of boats to choose from than ever before. No matter what your interest, there's a boat for you.

Boat Shows... The Fun Place To Start!

Boat shows are exciting events for the whole family. Each year, hundreds are held around the country for the specific purpose of providing you with the chance to learn

more about making the adventure come true. Boat shows give you the opportunity to see a wide selection of boats from many manufacturers, all in one place. Boat shows also allow you to window-shop, without obligation, for everything you may need: from motors and trailers, to accessories and financing.

Best of all, boat shows feature special price reductions that present a great opportunity to live the boating adventure for less.

FOR YOUR FREE 'GUIDE TO BOAT BUYING' WRITE: THE NATIONAL MARINE MANUFACTURERS ASSOCIATION (NMMA), 401 NORTH MICHIGAN AVE., CHICAGO, IL 60611.

\$3,550 total*
14 FT. DAY SAILER
(*Approximate total cost based on manufacturers' average prices.)

\$185 per month
22 FT. CUDDY CABIN
w/AUX. OUTBOARD
(Based on 20% down at 13.5% interest per year over 7 years.)
Approximate cost: \$12,500.00

\$293 per month
26 FT. POWER CRUISER
w/INBOARD/OUTBOARD
(Based on 20% down at 12.5% interest per year over 10 years.)
Approximate cost: \$24,995.00



Contact these participating Cmon Aboard manufacturers for more free information:

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Outboard Motors • 800/255-2550

Johnson Outboards
Outboard Motors • 800/255-2550

Mariner Outboards
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MerCruiser Sterndrives
Sterndrives • 800/447-4700

Mercury Outboards
Outboard Motors • 800/447-4700

OMC Drive Systems
Sterndrives • 800/255-2550

Yamaha Outboards
Outboard Motors • 800/447-2882

Sea Ray Boats
Powerboats & Cruisers • 615/522-4181

Volvo Penta of America
Gas/Diesel I/O's, Inboards • 800/445-BOAT

Four Winns, Inc.
Powerboats • 616/775-1351

Minstar Boat Group
Hatteras Yachts Powerboats • 919/889-6621

Larson Boats Powerboats • 612/632-5481

Lund Boats Fishing Boats • 218/385-2235

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Cruisers, Runabouts • 800/BE REGAL

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Carver Boat Corp.
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*Cmon
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THE ALPHA ONE.TM AND ONLY.



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Only one stern drive outsells all others combined. Only one stern drive has been chosen by over a million boaters. Only one stern drive has a servicing network 5500 dealers strong. And only one company could introduce a stern drive this advanced. The same company that advanced stern drive power in the first place. MerCruiser introduces the Alpha One. And still, the only. **MERCUISER ALPHA ONE.TM**



Circle 34 on Reader Service

OUTDOORS

(Continued from page 16)



A "mainless" double-head rig gives the Delta 26 surprising upwind performance.

Blown away

Sailors are habitual tinkers, so it's not surprising that someone finally came up with a means of doing away with the conventional mainsail. It's also not surprising that that someone turns out to be Garry Hoyt, the Newport, Rhode Island, innovator who invented the stayless Freedom rig nearly a decade ago. The mast on Hoyt's Delta 26 is mounted at the extreme after end of the hull and supports two headsails, which provide motive power upwind. Off the wind, Hoyt created a fully battened roller-furling spinnaker (believe it or not) that deploys and douses with untypical ease. Harken ball bearing running blocks throughout the Delta 26 make sail-setting systems run easy. If you'd like to learn more, contact Garry at One Harborview Dr., Newport, RI 02840.

Wonder reel

By now, graphite is old news in fishing reels. What does make headlines, though, are the new and different ways tackle manufacturers are using this superlight, superstrong material. We'll be reviewing various types of angling equipment in the months ahead with this in mind, and have chosen to lead off



Garcia's Polaris 2 packs several fish-catching features into a streamlined profile.

with Garcia's new Ambassador Polar-2 baitcasting reel. Its teardrop profile is indeed attractive, but the real interest lies in the mechanisms Garcia is able to pack into its \$100 unit. Consider the fingertip Command Panel, for instance. It lets the angler choose among five different useful options like thumb-bar casting and spool release, a switch for flipping or conventional casting, anti-reverse to fight line tangles, a line-out alarm and 10 mechanical brake settings. The 9-ounce reel also has a capacity for 100 yards of 20-pound test line. All interesting stuff from one of the world's leading tackle makers. For more information, contact Garcia at 21 Law Dr., Fairfield, NJ 07006.

Fish finder update

Sharp-eyed readers no doubt noted in January's column that the rectangle that was supposed to have been superimposed on the Lowrance X-16 paper graph recorder screen was missing. The correct set of photographs—with rectangle in place—appears below, and illustrates the differences in coverage between traditional paper graph recorders and the new LCD machines. The rectangle on the paper graph re-



The rectangle on the X-16 represents the same coverage you get with the LCD X-3.

corder equals the coverage offered by the entire LCD unit. Obviously, the paper graph recorders cover much more area compared to the current state of the LCD art. In some cases, Ioran C interfaces allow Ioran coordinates to be imprinted directly on paper graph charts, and paper graph charts generally offer much better definition. LCD units, in their favor, are often less expensive and have a much lower amp draw. They're also cheaper to operate, since they have no graph paper to continually replace. Watch for finer pixel density in the next generation LCD fish finder, particularly in the Lowrance X-5. **PM**

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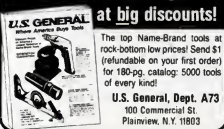


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Freewheeling

BY WADE HOYT



All-aluminum Audi

What would you think of a rust-proof aluminum car that was stronger than steel, delivered better fuel mileage, and had a higher scrap value so that, when it finally bit the dust, it would still be worth more than an Iron Age car? Audi and Alcoa are betting that you'll like it enough to overcome a hefty price premium.

Since 1982, the two companies have been quietly trying to figure out how to build a unitbody car entirely out of aluminum. The result is a small run of all-aluminum Audi 5000 bodies "in white" first shown at the Hannover Trade Fair. The body and chassis combination weighs only 328 pounds, a saving of 288 pounds, or 47 percent, over the standard all-steel unitbody. A lighter chassis, in turn, would allow further reductions in the size and weight of brakes, suspension

and other components.

The advantages are obvious—higher performance and/or greater fuel economy without downsizing current models. In general, luxury-car buyers have been avoiding downsized models like social diseases. Audi claims that the all-aluminum unitbody would create no sacrifice in comfort, durability or strength. The chassis is 14 percent stiffer than steel, and the body has slightly better dent resistance.

The unitized chassis pieces were redesigned to take advantage of aluminum's properties. Thickness was increased in some areas, box sections changed in others. Chassis pieces were made on standard production presses in the Audi factories in West Germany.

The stampings were not welded together, but riveted in a process usually associat-

ed with jet aircraft. Spot-welded aluminum joints have only 87 percent of the strength of spot-welded steel. Riveted aluminum has 99 percent of the strength. In high-stress areas, joints were both riveted and bonded with epoxy. These joints have 23 percent more strength than welded steel.

Industrial robots were "taught" to rivet by using riveting fixtures in place of the familiar welding fixtures. The riveting robots can be programmed to do the job on the assembly line, just as today's robot welders do. The pneumatic riveting fixture first punches a hole through the two sheets of aluminum, dimples them if a



Riveted engine support does the same job as steel part.

countersunk rivet is required, then rotates its riveting head into position and pounds an aluminum rivet into place.

Curing the body paint in a conventional paint oven ages the Alcoa 6009-T4 aluminum-magnesium-silicone alloy to a tougher T6 temper,



Robot riveter punches holes and installs 30 rivets per minute.

more than doubling its strength. This is one of the neatest parts of the process because the softer T4 alloy is much easier to shape and draw in the stamping process, but not strong enough for the finished vehicle.

Right now, aluminum has a significant cost penalty vs. steel. An aluminum Audi would cost 10 percent more than steel. However, its estimated 15 percent reduction in fuel consumption would save some 800 gallons of fuel during a 100,000-mile service life.

Audi's vice chairman of research and development, Dr. Ferdinand Piech, is a grandson of Ferdinand Porsche, the legendary sports car engineer. Audi has already managed to justify the adaptation of such high-priced tech as turbochargers, 4-wheel drive and ABS brakes.

It's not likely that any current Audi would be switched over to aluminum construction. But when the next new Audi is introduced, certainly before 1995, you can expect it to be all aluminum—body, chassis, suspension, engine, and maybe even the drive axles and brakes.

So far, so good. But what will it mean to the local body shop when it has to deal with a car that's put together like a jet plane? To the home handyman, drilling, riveting and applying adhesive is a lot easier to do than welding. To the body shop, it's a whole new ball game.

FM



Two strong girls hold the 328-pound aluminum Audi "body in white." Steel unit weighs 616 pounds.

Homeowners' Q&A



BY NORMAN BECKER, P.E.

Leaking basement wall

I have a nagging problem with water seeping into my basement after a heavy rainfall. Perforated drain pipes under the basement floor do a good job of relieving hydrostatic pressure below the slab. However, the cavities in the concrete block walls fill with water, which leaks into the basement.

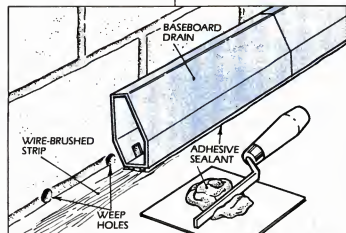
Contractors recommended breaking up the floor at the perimeter and installing drain tiles and a sump pump. However, I recently heard about a plastic molding, similar to a baseboard radiator cover, that is sealed to the inside of the foundation wall along the floor. Holes are drilled into the blocks to drain the water from the cavities into the molding, which carries it to a sump. Can you tell me more about this arrangement?

GEORGE F. SENN
RED BANK, NJ

There is such a product, and it does work. But the ideal way to correct a hydrostatic leakage problem in a concrete block wall is to intercept or divert water before it reaches the foundation (see Homeowners' Clinic, page 20, Sept. '85).

However, if you can't lay drainage pipes because the area around the foundation is paved or covered with expensive shrubbery, or is otherwise inaccessible, then you must control the seepage into the basement. You can do this as you describe, by puncturing weep holes at the base of the concrete blocks and directing the effluent to a sump pit, where it can be pumped from the house.

Basement Water Control Corp., 1375 Laurel Ave., St. Paul, MN 55104, makes a hollow vinyl baseboard that collects wall seepage and channels it to a sump. It's



Water seepage via cement block foundation walls can be channeled through weep holes into hollow vinyl baseboard, then to a sump hole where it is pumped out. Baseboard is secured with adhesive sealant to a wire-brushed strip on the concrete floor.

sold at home centers and building supply outlets for about \$4 per linear foot, including a special adhesive sealant that cures even under wet conditions. Corner sections, splices and end caps are also available. It should be noted that this system isn't viable in cases where water is forced up directly through the floor by hydrostatic pressure.

Double-layer roof shingling

My 25-year-old house needs reroofing, and I plan to do the job myself. I would like to lay new shingles over the old ones. However, the builder apparently skimped on the roof sheathing. Instead of the usual $\frac{1}{2}$ -in.-thick plywood, he used $\frac{3}{8}$ -in. sheets. Also, he nailed the shingles directly to the sheathing without putting down building paper.

Can I add a second layer of shingles? Or would this be too heavy for the $\frac{3}{8}$ -in. plywood, considering there can be a foot of snow on the roof in winter?

G.P. OEY
ITHACA, NY

The builder didn't necessarily skimp on the roof sheathing. The required thickness depends on rafter spacing, the grade of the plywood, and the direction of its face grain.

Look for the American Plywood Assn. (APA) stamp on the exposed underside of the plywood for the identification index. The index contains two numbers, such as 20/0 or 32/16. The left-hand number represents the maximum recommended spacing in inches between rafters when the face grain of the panel runs at right angles to the rafters. If the rafter spacing is not greater than 24 in., your $\frac{3}{8}$ -in. sheathing is adequate.

I suggest you check with your local building department about a second layer. If your town allows only one layer, you'll have to tear off the existing shingles.

The builder did skimp on the roofing paper. The paper serves as a backup water

barrier between the shingles and sheathing if shingles are lifted, damaged or torn off by winds. The Asphalt Shingle Manufacturing Assn. recommends using building paper. However, with a second layer of shingles, the absence of building paper is less critical.

Attic ventilation

Our home's previous owner closed off one of the gable louvers when he installed aluminum siding. One other vent was left open. Is there a way to get adequate ventilation without removing the siding or tearing up a lot of shingles? Will a turbine or similar device help?

SANDFORD WIL
MILWAUKEE, IL

Your problem is common in houses that have been resided with aluminum. Many installers cover vents with siding that has only small slots, and these give inadequate ventilation. Installers should frame around the vent, then trim around the framing with siding, so the vent size is not reduced.

One easy way to correct your problem is to install a roof vent on the rear slope of the roof so it is not visible from the street. The contractor who installs the vent should place it near the gable end and cut a hole in the roof just large enough to contain the vent casing. This way, very few shingles will have to be disturbed.

To ensure adequate ventilation, you may also want to consider installing soffit vents. Keep in mind that total ventilation opening size for an attic should be 1/300th of the attic floor area when there is a vapor barrier on the insulation, and 1/150th of the floor area when there is no vapor barrier.

FM

Do you have a home-maintenance or repair problem? Send it to Homeowners' Q & A, Popular Mechanics, 224 West 57th St., New York, NY 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in the column. For more home-repair and maintenance help, get FM's Home Care Guide, \$2.49 postpaid. Send your order to Popular Mechanics, Box 1011, Radio City Station, New York, NY 10101.

What not to do in bed.

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You can eat breakfast.

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You can listen to music.

You can exercise.

You can snore.

You can even eat crackers—
provided you're alone.

And yes, you can snuggle.

But don't ever light up a cigarette
when you're in bed.

Because if you doze off just once,
all your dreams can go up in smoke.

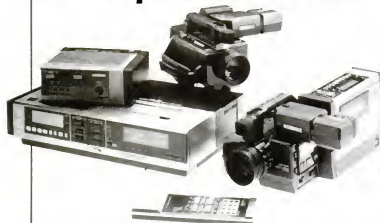
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Home Video



BY JAMES B. MEIGS

Closeup: Kodak's 8 mm



Kodak's MVS 8-mm video system lets you mate camera and recorder to form the camcorder, recorder and tuner for home deck.

Will 8 mm make it? Ever since the compact video format was first introduced on the market two years ago, I've heard this question more than any other.

I think it will be many years before 8 mm catches up with Beta and VHS home decks. But in the field of portable video, especially camcorders, 8 mm has some remarkable advantages that could help it dominate this part of the video universe.

Recently, I had a chance to try out Kodak's new MVS 8-mm video system, a package of gear that shows not only how far the format has come, but also where it might be heading.

The system is modular, consisting of a video camera, portable VCR and a stay-at-home tuner/timer. All the components snap (or "dock") together. Combine the VCR and the tuner/timer sections, and you have a very compact and unusual tabletop VCR.

Snap off the VCR again and add the camera, and you've created a camcorder.

Kodak gives buyers a good deal of choice by making two versions of the system available. The more expensive package includes the MVS-500 VCR (\$1000), which in addition to offering the high-quality monaural FM audio used in all 8-mm systems, can also record and play back PCM (pulse-code modulation) digital audio tracks in stereo. The matching tuner/timer (MVS-380, \$600) adds an MTS (Multichannel TV Sound) decoder for receiving and recording TV shows broadcast in stereo.

PCM digital recording is, to me, one of the most exciting capabilities of the 8-mm format. While there are some tabletop VCRs with this feature, the modular design of Kodak's top-priced model makes it the first camcorder able to record digital stereo (this requires an op-

tional stereo microphone). The recorder can also double as an audio-only digital tape deck, recording up to 12 hours on one 8-mm cassette.

But before you throw out your Compact Disc player, take a look at 8-mm's digital audio specs: They don't come close to CD. In fact, they're not as good as what Beta Hi-Fi or VHS Hi-Fi offer. Listening both to soundtracks recorded using the system as a camcorder and to music dubbed from other sources, the 8-mm digital system's audio limitations were audible but certainly not intolerable. I found the system perfectly adequate.

In video performance, the MVS system is somewhat improved compared to most earlier 8-mm recorders. In standard-play, the picture easily matches VHS or Beta. Still, I have some complaints about the system.

While the recorder is much improved, I don't feel the camera portion is up to

the performance of the rest of the system. The sample that I experimented with showed visible lag and off-color edges around objects in the picture.

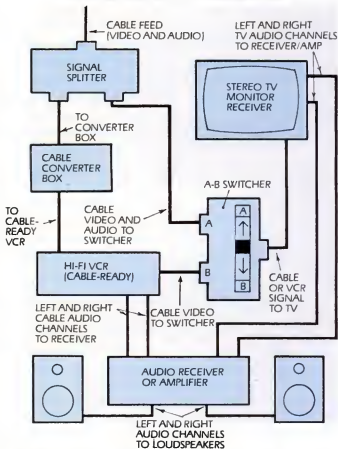
And, though the overall engineering of the system is ingenious, I wonder if Kodak hasn't made its new 8-mm generation too sophisticated. The system might appeal to technology buffs, but I'm afraid the complete package may be too complex for many Sunday-afternoon movie-makers. Though video fans interested in simple aim-and-shoot moviemaking should take a look at Sony's tiny Handycam, Kodak's approach to 8-mm video does show how versatile the format can be.

Get set: Part II

If you have cable television, hooking up a VCR is more complicated than usual. Almost all the VCRs on the market today claim to be "ca-

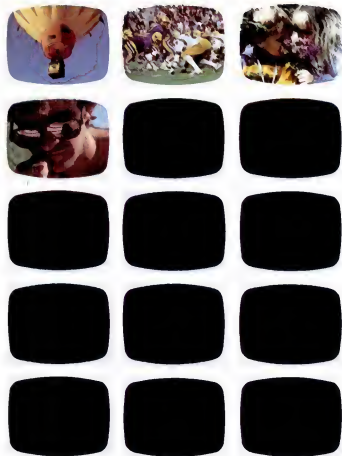
(Please turn to page 30)

VCR-CABLE TV HOOKUP



Hookup lets you watch cable while recording the pay channel by splitting the incoming signal and using an A/B selector.

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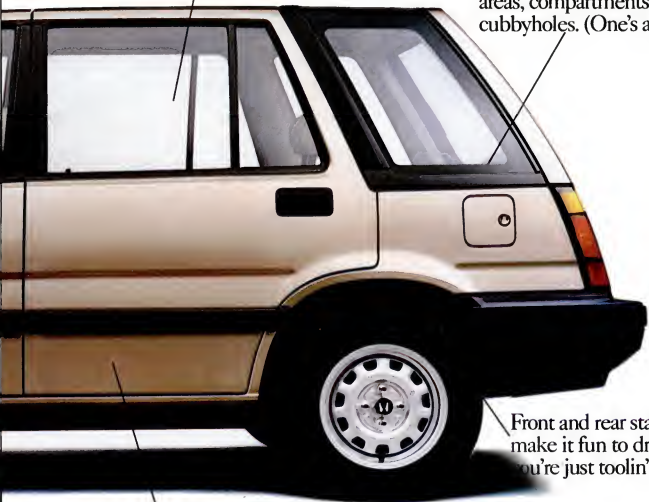


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power tool.

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HOME VIDEO

(Continued from page 26)

ble ready." But that doesn't mean you can just plug in the VCR and get every cable channel.

For one thing, your VCR's tuner will need to have enough ready channel capacity. If your cable company locates channels throughout the VHF, UHF and hyper-band frequencies, your VCR could need well over 100 channels to tune in all of them.

In other words, in order to find the right frequencies for various channels, your VCR may need more capacity than the total number of channels your cable company actually provides.

But even if you can't tune in every single channel, using your VCR tuner to select channels is still usually much more convenient than using the converter box supplied by the cable company. The VCR tuner will let you zip through channels by remote control. If you use the cable converter box and feed its output to VCR, you can only feed one channel at a time—and you'll need to get out of your chair whenever you want to change it. You also will have to leave the box set to the proper channel if you want to record a program while you're away from home. And, of course, your VCR will only be able to record programs on that one channel while you're away.

The biggest problems occur when trying to hook up pay-TV channels (such as HBO) that are scrambled by the cable company. To view or record these channels you will need to use the converter box to descramble the signal. If you plan to record pay channels frequently you will need to provide an output that runs from the converter box to the VCR.

One way to do this (see diagram) is to split the incoming signal with an RF splitter. Feed one cable from the splitter into the cable box and from there into your VCR. The other cable goes to an A/B switch—a device which selects between it and the VCR's output to feed whichever signal you choose to go to the TV set. This setup will let you watch one basic (or non-pay) channel while you tape another cable channel, if you already have a cable-ready TV. If you would rather watch pay channels while you tape from basic cable, feed the output from the cable box directly to the TV, and feed the other cable input right to the VCR.

Though working out all the possible ways to combine VCR, TV and cable converter boxes seems like an exercise in higher logic, with a pencil and a sketch pad it's not too hard to work out the arrangement that will let you do the things you really need. All it takes is plenty of 75-ohm coaxial cable and a

couple of extra splitters and A/B switches. But remember, if you want to have complete flexibility (such as being able to watch and record two different pay channels at the same time) you'll need an additional cable-converter box—and the cable company will want to sock you for an additional fee.

The VCR wiring maze gets still more complicated when you start hooking up audio gear, as shown in the diagram. Basically, you route cables from the Audio Out jacks on the VCR (or even TV) to the input jacks (marked AUX or VIDEO) on your hi-fi amplifier or receiver. The same cable route holds true if you've got audio or video signal processing components (such as a graphic equalizer) between the video gear and the amp/receiver.

Accessory or necessity?

Some accessories companies have come to the rescue of new VCR owners by offering packages called starter kits. For example, Discwasher's package really does help you get started. In addition to an RF splitter and A/B switch—crucial for anyone with cable TV—this starter kit includes a variety of cables and, more important, a very handy guide to hooking up a VCR. The wiring diagrams cover a variety of hookups and they alone almost justify the price of the kit.

Recoton takes another approach: Its splitters, A/B switches and other wiring accessories are packaged individually and labelled according to the task you need to perform. For example, if you want to watch one cable channel while taping another, the proper components can be found in the box carrying that label.

Digital effects

If you believe VCR prices will go the way of calculator prices, consider that a large part of a VCR's cost is the expense of its mechanical parts. Most costly is the video head drum—a component probably machined more precisely than any other piece of metal in your home or car.

While printed circuitry cuts the cost of VCR electronics, the mechanical cost is harder to reduce. This is why manufacturers hope to include digital circuitry in VCRs.

A VCR with enough solid-state memory to hold a couple of frames of video could produce crystal-clear freeze frame and slow-motion effects. In fact, Toshiba and others have demonstrated 2-head VCRs with these digital effects. It's likely we'll see a few models later this year.

The first digital-effects recorders won't be money-savers, but the technology should eventually bring high-class effects to budget decks. **PM**

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Appliance Q&A

BY STEVE TOTH



Removing an agitator

I have a Norge AWG 1210A, 12-pound-capacity washer, serial No. 51217. To repair it, I must remove the tub, but I can't get the agitator out.

R. CARIDEO
MALDEN, MA

The agitator's cap holds the agitator to the drive block, which is at the top end of the agitator shaft. The cap unscrews counterclockwise and once it's removed, the agitator can be lifted off. However, if the agitator hasn't been removed for a long time, detergent residue may have built up under it, gluing it to the drive block. If this is the case, there are several ways to free it.

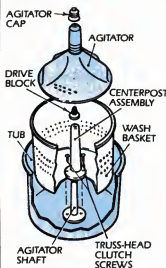
First, loosen the agitator cap and leave about 1/4 in. between it and the top of the agitator. Set the timer to a normal wash cycle and fill the tub to its highest level with hot water. Let the machine agitate for a while. Then turn off the timer and check the agitator to see if it has loosened up.

If it is still not free, remove the agitator cap and let the agitator sit in the hot water for about 20 minutes. Turn on the washer and pump out the water in the tub. Unplug the washer and grip the agitator with both hands, sliding your fingers between the agitator and the basket. Wear gloves, or use towels, if the agitator is too hot to handle. Rock the agitator from side to side while lifting up on it.

If this method fails, squirt penetrating oil between the

drive block and the agitator and give it time to soak in. Then tap around the top of the agitator with a rubber mallet. The tapping should loosen the agitator. Be careful not to hit the agitator too hard so it cracks. A replacement is no longer available from the manufacturer.

Once the agitator breaks free, the wash basket can be lifted out after removing the four 1/16-in. truss-head clutch screws that hold the basket to the center post assembly. You may need a special butterfly-shaped truss-head clutch screwdriver to remove these screws, which you can buy either at an auto supply store or a tool supply distributor. After the basket is lifted out, you will have access to the tub.



To remove a "frozen" agitator, apply penetrating oil to drive block, or fill tub with hot water and allow agitator to soak.

Rusty rack

I have a 10-year-old Kitchen-Aid dishwasher with a rusted bottom dish rack. Sometimes the rust leaves black marks on my dishes. How can I fix this? ANN CROSS
MARLBORO, MA

Corrosion Guard, a coating made for dishwasher rack repair, should solve your problem. It comes in a ready-mix applicator in blue, white, almond, green and clear.

Before applying it, clean grease and residue from the rack. Peel off any old coating material that is loose, and sand heavily rusted areas with emery cloth. Brush on the liquid in layers, at 30-minute intervals, applying as many coats as necessary. Wait 24 hours before using the basket. Corrosion Guard sells for \$6.95 postpaid from Advance Materials, 502 Hwy. 74 North, Peachtree City, GA 30269.

Buzzing washer

I have a Sears washer, model No. 110.82194870, serial No. C30902065. During the beginning of the wash cycle, it buzzes very loudly. I've replaced the motor start capacitor and the start switch, but this hasn't helped. The machine washes properly, but the noise is so loud it's annoying.

ROBERT A. PINGLE
IRVINE, CA

The buzzing noise is probably coming from the solenoid on the detergent valve, which is located behind the front of the machine just to the right of the recirculating pump. The solenoid is energized for the first four minutes of the wash cycle to pump wash water to the detergent dispenser, flushing the detergent into the tub.

To check the solenoid, disconnect the power to the machine and remove the two hoses from the detergent valve. Look inside the valve to be sure nothing is preventing the flapper from closing all the way. If the flapper doesn't seat properly, the solenoid will continue to be

activated, causing it to buzz.

If the valve is okay, reconnect the hoses, then loosen the screws holding the solenoid to the mounting bracket. Shift the solenoid slightly, and retighten the screws. Sometimes simply re-aligning the solenoid will clear up the problem.

If both these measures fail, you'll have to replace the solenoid. The part number is 362832. It costs about \$16 at Sears appliance parts stores.

Fry pan elements

I own two older broiler-fry pans which need replacement elements, but these elements seem to have disappeared off the market. I have a Westinghouse Model HL-52 and a Hoover Model B3039. Both elements were made by Chromolux, part No. 873244003, 120 volts, 1175 watts. Do you have any idea where I could find this part? I'm sure there are lots of other people out there with the same problem.

PETER MATJEWICH
BURGETTSTOWN, PA

I located several sources to check replacement elements but Chromolux Co. stopped manufacturing them several years ago. However, all is not lost!

Southeastern Electric Range Parts Manufacturing Co., 301 South Linwood Rd., Gastonia, NC, assures me that they can probably duplicate your fry-pan element. They suggest you send them your old elements and all the information you can, such as manufacturer's name, voltage and wattage of the elements.

After mailing the package, allow a few days for delivery, then call the company, toll-free, at 1-800-438-8364. They will give you a price for the new element, and the shipping cost. **TM**

If you have a problem with any appliance, send your question, along with the model and serial numbers, to Appliance Q & A, Popular Mechanics, 224 West 57th St., New York, NY 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.

New Home Security Device Stops Burglars

Introducing the best bargain in low cost home security! Now you can protect your home and family in minutes.

Better Than Burglar Alarms

Law enforcement officials will tell you a dark house is like an invitation to a burglar, and that leaving your lights on when you are away from home is one of the best ways to make it look occupied. But leaving the lights on all the time costs money and rarely fools the professional criminal.

Let AudioLites Guard Your Home

AudioLites turn ordinary lights into sound activated security systems. If anyone even approaches your home, AudioLite sensors pick up the sound and flood your yard with light, room lights come on instantly and intruders are frightened away.

Never Stumble In a Dark Room Again

Unlighted rooms, stairways and outdoor areas are often hazardous due to inconvenient or hard to reach light switches. AudioLites light your way the minute they hear you coming. Just imagine the safety and convenience of having your driveway light up the moment your car approaches.

AudioLites Work Anywhere

Each AudioLite can be adjusted to turn on at varying sound levels. With a small screwdriver, you set the amount of sound needed to activate the lights . . . anything from a whisper to a loud shout. Lights are timed to stay on up to two minutes. Each new sound triggers the internal timer and begins a new countdown. So lights stay on while you're in a room and go off automatically when you leave. For quiet activities, AudioLite has a manual on-off switch.

30 Day Money-back Guarantee

Solid state construction and quality craftsmanship means no wear and tear on parts. AudioLites are UL approved and come with a ONE YEAR REPLACEMENT WARRANTY. Try our AudioLites for 30 days, risk free. You'll wonder how you ever lived without them. If you don't agree that they add security, safety and convenience to your home, just return them for a prompt full refund.

Free Shipping and a \$20 Savings When You Order 4 or More!

To give you total home protection, you'll want more than one AudioLite. Order 4 or more AudioLites and enjoy our extra discounted price of just \$19.95 each. That means a package of 4 is just \$79.80. **YOU SAVE \$20!**



Stops burglars by turning on lights before they break in.

Extra Bonus — Order Today!

And, if you order today we'll include eight FREE Burglar Alarm Warning Stickers for your windows and doors, with any order of 4 or more. A \$3.95 value.

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Order today by calling: 1-800-525-8624 (In CO 303-762-1385). Or, send this order coupon to: Progressive Energy Corp., 3148 S. York, #PM286, Englewood, CO 80110

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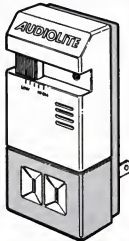
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Three Easy Ways to Protect Your Home in Minutes



The AudioLite Socket is as easy to use as screwing in a light bulb. This is the AudioLite created for outside flood lamps, driveways and walkways. Works with up to 150 watts.



The AudioLite Plug plugs into any standard outlet and is designed to be used on interior room lamps. Any room with a lamp can be sound activated. The plug is portable and can be used anywhere. Works with up to 300 watts.



The AudioLite Switch turns on ceiling lights. It's terrific for dark stairways, hallways, entry ways, basements and garages. It installs quickly and easily in place of your present light switch using just a screwdriver. It takes only a few minutes, even for a novice. Works with up to 200 watts.

Minicourse



BY ROSARIO CAPOTOSTO



Cutting glass

Cutting glass is an easy task, one that can be mastered in short order by following the procedures shown here. The cut is made by first scoring the glass, then snapping it. To score it, you use a glass cutter—a simple tool that consists of a small cutting wheel mounted on the end of a slender handle. The proper grip of this tool is essential. It should be held firmly between index and middle fingers to provide maximum control of the stroke.

For best results, be sure to work on a flat surface cushioned with newspaper. Mark your cut line, then hold a straightedge firmly in place on top of the glass. Lubricate the cutting wheel by dipping it in kerosene, then stroke the tool along the guide in a steady, continuous pass using moderate pressure. Avoid stopping and restarting, and above all do not make a second cut over the first—this usually results in an erratic break.

Once the glass is scored, place a dowel under the line, then press down gently on both sides of the glass. Make this break immediately after the scoring. If you allow a few hours to lapse, the glass will tend to break poorly.

The cutter shown here is a new design and it works very well. It has an internal reservoir that dispenses kerosene onto the wheel when pressure is applied. Called the Scoremaster II, it's made by Fletcher-Terry

Co., Spring Lane, Farmington, CT 06032. It sells for about \$15 at hardware stores and home centers.

Glass cutters should be held between index and middle fingers to give best control. Traditional cutter on right has notched handle for snapping narrow strips, while newer version has self-lubricating carbide wheel and a comfortable contoured grip.



Measure and mark cut line, then use straightedge to guide cutter. Pull tool across glass—from edge to edge—using one firm stroke.



Once the line is scored, slide dowel under the line and gently press down on both sides to snap glass apart. Table edge can also be used.



If you need an especially smooth edge, the edges of the glass can be eased using a water-soaked oilstone. Rub the stone lengthwise.



To cut narrow strips, first score the surface, then tap the underside of cut line with the end of cutter handle. Snap off glass with pliers.



To cut circles, score the surface with a rotary cutter, then make radial lines with a straight cutter. Tap from below to break off waste.



To drill holes in glass, create lubricant dam with clay. Pour in kerosene, then drill at low rpm using a carbide glass drill bit.



© 1986 FMPM

Shown smaller than actual size. Length approximately 8 1/2"

"No one in his right mind would go through all this to make a model car."

The 1935 Mercedes 500K Special Roadster.

It sets a standard few, if any, die-cast models have ever approached.

A masterpiece in miniature, it is the first in Franklin Mint's extraordinary new series, The Great Classic Sports Roadsters.

A CUSTOM MODEL OF THIS QUALITY WOULD COST THOUSANDS OF DOLLARS.

Director Gordon Buehrig's determination to create a 1:24 scale model of unparalleled authenticity, detail and craftsmanship required dedication to excellence every step of the way.

An exhaustive search located, from the fewer than 20 originally made, the best of the 500K's still extant today.

The best had recently been voted Best in Show at Concours d'Elegance. From hundreds of photographs and precise measurements of this splendid example, a prototype was built.

From specially made tooling, 111 precision pieces were created, as opposed to the roughly 40 pieces that make up the average model.

Each piece individually inspected.

Each body piece then hand-painted with actual automotive lacquer. The precise Mercedes 500K color.

Each piece then hand-waxed to a high gloss and reinspected. Imagine hand-waxing a model car. The 111 finished pieces finally hand-assembled to form a single car.

Dedication had become compulsion.

ITS OPERATIONAL FEATURES AND INTRICATE DETAILING ARE REMARKABLE.

There is remarkable duplication of the original's extraordinary amount of gleaming chrome trimwork, precisely placed, down to the tiny tips on either of the fender-tred rublines.

Hood, doors and trunk that open and close.

A boot that snaps off.

A convertible top that snaps on.

Full dashboard instrumentation.

Scale-exact tire tread. A "knock-off" hub that covers both spares.

Seats into which just the right amount of "give" has been built.

Engine detailing that includes a Roots-type blower, carburetor and ignition system.

Running gear and suspension on the undercarriage.

Compulsion had become obsession.

And finally, the result is here.

THE MAGNIFICENT MERCEDES IS AVAILABLE ONLY THROUGH THE FRANKLIN MINT.

Crafted and imported exclusively by Franklin Mint Precision Models, the 500K is being offered at the remarkably low price of \$90. Upon receiving the order form at right, payment will be billed to you in 3 installments of \$30 each.

"We were determined to make the ultimate in die-cast models," said Mr. Buehrig. "We succeeded!"

ORDER FORM

The Mercedes 500 K Special Roadster

Please mail by March 31, 1986

Franklin Mint Precision Models
Franklin Center, Pennsylvania 19091

Please enter my order for The Mercedes 500K Special Roadster, crafted in die-cast metal, to be sent to me fully assembled and ready for display.

I need send no money now. I will be billed for my model in three monthly installments of \$30 each, beginning just before the car is ready for shipment.

**Plus my state sales tax and a total of \$3. for shipping and handling.*

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52

FRANKLIN MINT  PRECISION MODELS

Computers



BY RON SCIBILIA

Rise of the econocloners



Epson's Equity series offers IBM compatibility at economy prices. Above, from left, are Equity I, II, and III computers.

Combine IBM PC compatibility with economy prices and you have a package that should open the world of microcomputing to a whole new class of users.

That's the thinking behind products such as Tandy's Model 1000, Leading Edge's Model D, the Bondwell 18 and Kaypro's PC. You can expect a flood of these econocloners, particularly from the Far East. One new entrant at the low end of the IBM-compatible market is Epson America.

Epson has now expanded its micro offerings beyond its current QX series with a new line that offers virtually total compatibility with off-the-shelf IBM PC software and IBM compatible hardware. Moreover, like Tandy's 1000, the leader model starts at a 3-figure price tag.

The lowest priced series, dubbed the Equity I, comes in three configurations that offer variable degrees of data storage. There is a single-floppy-disk version (\$995), a dual-floppy (\$1295) and a single-floppy plus 20-megabyte (20MB) internal hard disk (\$2195). These

prices don't include a video card or display monitor, but for about \$300 more you can get the card and a 12-in. monochrome monitor, while \$800 dollars buys a 13-in. RGB color display with graphics ability. That's real bargain pricing, and retail discounts are likely to produce even greater savings.

What's common to all three configurations is the Intel 8088 microprocessor, 256 kilobytes of random access memory (256KB-RAM, expandable to 740KB), a 360KB disk drive for 5¼-in. floppies, and a detachable IBM PC/AT-style keyboard. Other standard features include a Centronics parallel printer port and RS-232 serial port, the MS-DOS operating system and GW-BASIC, three standard IBM option slots, an 8087 numeric coprocessor socket, a loudspeaker and a front-panel AC reset. The Equity I computers share a small "footprint" that takes up little desk space. An optional 256KB-RAM expansion card costs \$169.

Epson also offers a II and III series with higher power and prices.

Winter league

Spring training is edging closer. But computer buffs with an itch for the national pastime can choose among a range of baseball programs to while away the evenings before regular play begins.

Random House's "APBA Major League Players Baseball" (\$90)—a computerized version of the venerable 30-year-old-plus board game—is designed for bugs who savor the statistical side of the game. This thinking man's simulation eschews visualized screen images of players and the diamond for the more cerebral pleasures of probability analysis. The realistic recreation draws on encyclopedic data amassed from actual big-league results.

APBA gamers can draft their own teams from a list of 676 players, or use the actual rosters for the 26 teams in both leagues. Players are rated according to such categories as batting average, speed, base stealing ability, hit and run success, strengths and weaknesses at the plate, fielding, arm strength and accuracy—including the pitcher's pick-off move and the catcher's throw to second base.

Statistics for up to 100 teams can be stored on each data diskette, and APBAers can print out box scores for each game played. The game offers ample opportunity for would-be managers to test

their diamond smarts as they call for the hit and run, steals, bunts, intentional walks, or shift the fielders, deal with injuries, rainouts and even ejections.

Taking a somewhat different tack is "Hardball" (\$30 to \$35), a program from Cupertino, California-based Accolade Inc. that strives to emulate a televised ball game with 3-dimensional field perspectives, including a view of the pitcher and batter from center field and behind-the-plate viewpoints of left field and right field. Players can use right- or left-handed hurlers and throw up to six different pitches. You get to strategize, too.

For computerphiles who plan to abandon the video field for the real thing come spring, there's "Dave Winfield's Batter Up!" (\$30 to \$40). This package from Avant-Garde of Novato, California, includes a tutorial on hitting from New York Yankee slugger Winfield and "Slugfest!", a batting challenge game.

Winfield advises young hopefuls on batting stance, swing height, grip, pitches to hit and hitting strategy. Pitches are based on the styles of several ace hurlers of the last four decades. Animated figures demonstrate different techniques at a number of different angles and speeds, and users can repeat the lessons in three speeds or even by frame. **PM**



Latest baseball simulation programs include Accolade's "Hardball."

GET THE KNOW-HOW TO REPAIR EVERY COMPUTER ON THIS PAGE.

Learn the Basics the NRI Way—and Earn Good Money Troubleshooting Any Brand of Computer

The biggest growth in jobs between now and 1995, according to Department of Labor estimates, will occur in the computer service and repair business, where demand for trained technicians will actually double.

You can cash in on this opportunity—either as a fulltime corporate technician or an independent service person—once you've learned all the basics of computers the NRI way. NRI's practical combination of "reason-why" theory and "hands-on" building skills starts you with the fundamentals of electronics, then guides you through advanced electronic circuitry and on into computer electronics. You also learn to program in BASIC and machine language, the essential languages for troubleshooting and repair.

You Build—and Keep—a 16-bit Sanyo personal computer

The vital core of your training is the step-by-step building of the 16-bit Sanyo MBC-550 series computer. Once you've mastered the details of this state-of-the-art machine, you'll be qualified to service and repair virtually every major brand of computer, plus many popular peripheral and accessory devices.

With NRI training, you learn at your own convenience, in your own home. You set the pace—without classroom pressures, rigid night-school schedules, or wasted time. You build the Sanyo IBM compatible computer from the keyboard up, with your own personal NRI instructor and the complete NRI technical staff ready to answer your questions or give you guidance and special help whenever you need it.

Praised by critics as the "most intriguing" of all the IBM-PC compatible computers, the new Sanyo uses the same 8088 microprocessor as the IBM-PC and

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the 8088 microprocessor functions, using machine language. You'll also prepare the interfaces for future peripherals such as printers and joysticks.

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Send the coupon today for NRI's big 100-page color catalog on NRI's electronics training, which gives you all the facts about NRI courses in Microcomputers, Robotics, Data Communications, TV/Vide/Audio Servicing, and other growing high-tech career fields. If the coupon is missing, write to NRI Schools, 3939 Wisconsin Avenue, NW, Washington, DC 20016.

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features the MS/DOS operating system. As a result, you'll have a choice of thousands of off-the-shelf software programs to run on your completed Sanyo.

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Photography



BY STEPHEN A. BOOTH

Switch-hitting 35's

Electronics has changed the way we take snapshots—for the better. The advent of inexpensive microprocessor "chips" makes it possible to

being used, advance it after each shot and rewind it when the roll's finished.

Fact is, the so-called "auto-everything" 35-mm



Canon's Sprint (left) has dual normal/macro lens. Minolta AF-Tele boasts normal/telephoto.



build 35-mm cameras that put the subject in sharp focus and set exposure perfectly, with no assistance from the photographer. They'll even pop the flash automatically, set correct speed for the type of film

compact is the most widely sold camera today.

The compact's small size, light weight and carefree operation make it popular

Accessories make Ricoh's autofocus AF-70 more versatile. These include adapter bracket that lets AF-70 use Speedlite 121A strobe, clip-on filter holder, telephoto and macro lenses.



among casual tourists and traveling photojournalists alike—especially so because the relatively large negative will produce very sharp enlargements.

Its only drawback, compared to conventional 35-mm cameras, is its lack of flexibility over lens range. Conventional cameras let the photographer switch lenses interchangeably: add a telephoto to bring faraway subjects closer, or a macro lens for detailed photographs of nearby objects. But with a 35-mm compact, you're

stuck with the lens that's built into the camera.

This lack of flexibility is in the process of change. The manufacturers of 35-mm compacts are giving customers the means to make greater use of their cameras. This versatility comes in two ways: Some companies build dual-purpose lenses into their point-and-shoot cameras. Others offer add-on lenses and other accessories that make an existing camera more versatile—but they leave the decision to you.

In the latter camp—separately available add-ons that let you roll your own camera—is Ricoh of West Caldwell, New Jersey. The company has developed a very flexible and pocketable system around its new AF-70 autofocus 35-mm camera, priced at \$175 but widely available for less. Accessories for the AF-70 include an auxiliary lens set (\$65) and filter holder (\$17). There's also a strobe adapter kit for \$35 that provides a bracket and post for connecting your AF-70 to Ricoh's \$35 Speedlite 121A strobe flash.

Using Ricoh's auxiliary lenses is simplicity itself. The long-range telephoto and close-up macro adapter simply clip over the built-in lens—and viewfinder. The

(Please turn to page 42)

PM PHOTO ALBUM—TIPS FOR BETTER PICTURES

Normally, people invest in lenses that produce sharp images. But in some cases, such as glamour photography, we want less detail in order to create fantasy—or hide minor flaws.

You can flatter your subjects with diffusion. Methods range from using special soft-focus lenses, filters or diffusion screens. Just about anything that scatters light when placed in front of a lens will work: hosiery, a filter smeared with petroleum jelly, even a thin layer of moisture.

The last method is the simplest. Install any clear filter on the lens and breathe on it after you've focused.

With SLRs, shoot when you see the desired amount of diffusion through the viewfinder. With compact cameras, breathe on the viewfinder as well to determine the extent of fogging.

In other words, watch the vapor evaporate, and then make the exposure when there's just enough misting left to achieve the

effect that you want. The photo at the right was taken this way. Note the glow of the jewelry.

—Armand Ensanian



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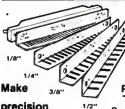


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PHOTOGRAPHY

(continued from page 40)

latter is a nice touch: It lets you see through the viewfinder exactly what your photograph will look like, thereby helping you to frame the shot as you'd



Kodak's TeleDisc camera has normal and telephoto lenses built in. Extending the flash engages the telephoto mode.

like it to appear. Another nice touch: Ricoh's macro lens incorporates a flash adapter that prevents your photos from becoming washed-out by the nearness of the flash to the subject.

Ricoh's filter holder attaches to the AF-70 the same way, and gives you lots of creative latitude. Into the filter adapter you simply screw on the filter of your choice. This could be a polarizer, to eliminate reflections, punch-up colors and screen out ultraviolet radiation that contributes that hazy veil to snapshots. Or, it can be any number of special-effects lens filters.

For action-freezing flash photography, Ricoh's AF-70 mounts onto an accessory bracket and adapter for its Speedlite 121A strobe. A light-sensitive diode on the adapter post senses when the AF-70's built-in flash has fired, and triggers the 121A. And the powerful 121A slave-strobe is so shielded that only the AF-70 triggers it. It can't be fired inadvertently by the flash from a nearby camera.

Other accessories for the AF-70 include belt-clips, a minitripod, and a variety of cases for lenses and camera. Having described the accessories, some words on the AF-70 are due.

This 8-ounce autocompact is one of the finest we've ever handled. The 35-mm f/3.5 lens is made of optical glass—not plastic. The autofocus system is stepless, from 3 feet to infinity, and flashes an alert when you're too close. Exposure is totally automatic, with shutter speed varying from 1/30 of a second to an action-stopping 1/500.

The flash module pops up automatically when the camera determines available light is insufficient. However,

you can defeat the flash for special effects, or use it in strong daylight when you want fill-in light to eliminate shadows. The AF-70 uses any film from ASA 100 through 1000 and automatically sets itself for the film speed in use, but may be manually set. Film loading and rewind are automatic; the self timer gives you 10 seconds to get in position. Two AA cells run the camera.

If you use the Vivitar PS35 autofocus compact, there's a telephoto/wide-angle adapter system (\$39) that attaches in a manner similar to Ricoh's clamp-on lenses. Meanwhile Canon, Kodak and Minolta offer cameras with built-in conversion lenses.

Canon, with its compact 35-mm Sprint (\$160), is betting most people want a macro lens for making sharp photos of subjects as close as 18 inches from the lens. Conversely, Minolta's AF-Tele (\$263) takes it for granted you'd rather zoom-in on distant objects.

Accordingly, Canon's autofocus f/3.5 lens converts to a fixed-focus (18 to 43 inches) f/12 lens for super-closeups. The neck strap becomes a measuring cord to determine macro-distance.



Auxiliary lenses for Vivitar PS35 are available in telephoto and wide-angle versions. They clip over regular lens and viewfinder.



In contrast, Minolta's AF-Tele uses a motorized 38-mm lens which, at the press of a button, extends focal length to 60 mm for telephoto shots of distant subjects. For its \$263 price, the AF-Tele offers several features not available in Canon's Sprint. One is a flash that deploys automatically in low-light situations—and which can be activated instantly for fill-flash shots in daylight. Additionally, the AF-Tele handles film speeds from ASA 25 to 1600; Sprint confines itself to popular 100 and 400 ASA filmstock.

Finally, if you prefer the simplicity of disc-film to 35-mm rolls, Kodak's new Tele-Disc (\$58) offers normal or telephoto shooting. Focusing isn't automatic, but it's fixed. In the normal mode, everything from 3 feet to infinity is in focus; with telephoto, range is 6 feet to as far as the eye can see.

PM

Amazing New Third Brake Light Can Save Your Life

Introducing the biggest safety breakthrough in the history of the National Highway Traffic Safety Administration (NHTSA).

Gov't approved Mandatory for 1986

Stringent government tests prove that the third brake light mounted at eye level reduces rear-end accidents by over 53%. The government is so amazed with these test results they are demanding all 1986 cars be equipped with this new third brake light. (These cars will be introduced in September of 1985.)

The NHTSA estimates predict that this light will prevent 900,000 rear-end collisions a year and 40,000 personal injuries a year. And when accidents do occur, tests show that personal injuries are reduced. Car damage and repairs are also reduced by almost 60%.

Here's why it works

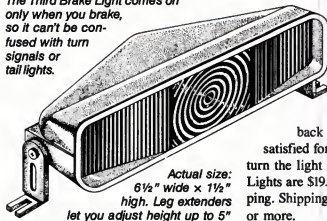
Mounted at eye level, the brake light is bright and easy to see because it shines directly into the eyes of the drivers in the second and third cars behind you. Also, since the light comes on only when you brake, it can't be confused with turn signals or tail lights.

Reduce rear-enders

The third brake light can prevent painful whiplash injuries, remind tail-gaters to back off, and gives the driver behind you better depth perception, day or night.

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The Third Brake Light comes on only when you brake, so it can't be confused with turn signals or tail lights.



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The versatile design of our light comes complete with everything you need — so it fits every kind of car. The patented bulb assembly snaps out for easy bulb replacement. The contemporary style has a low profile — so it looks good on all vehicles.

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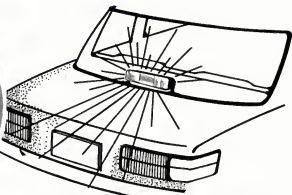
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Cycles



BY NORMAN MAYERSOHN

Kawasaki one-ups itself



PHOTO BY RICH COX

To satisfy the select few Ninja masters who have outgrown the 900, Kawasaki adds the 158-mph Ninja ZX1000R to the '86 line.

Last year we all thought that the engineers at Kawasaki had painted themselves into a corner. Their ultimate canyon racing creation, the Ninja 900, clearly ranked at the top of the super sports cycle class, and we thought it would have to be an impossible act to follow.

So they blind-sided us with an end run. In 1986 the Big K will again offer the 900, and they've added the ZX1000R we see above. AI-ready run to 158 mph by the left-coast motorcycling press (in showroom trim) the newest Ninja delivers a crystal-clear message—there's no truce in the horsepower war, not even hope of a cease fire.

Now, why would we get all hot and sweaty over an existing model that's just

been pumped up with 89 cc more engine displacement? Well, as quick as advances come in the Superbike class, Kawasaki knew it had to do a lot more to stay ahead of the other guys. Cam timing has been altered to beef up the high-rpm part of the power curve, and both the connecting rods and clutch are stouter than are the 900's innards.

Engine cooling, always marginal on the smaller Ninja, is uprated with a bigger fan and larger radiators for both engine coolant and oil. Moreover, the fairing has sprouted new ducts to route air to the cooling system, exhaust pipes and carburetors.

A new perimeter-design frame, like the one used on the 600 Ninja, allows rubber mounting of the engine.

Used together with internal counterbalancer, the Ninja 1000 has been turned into one of the smoothest inline Fours we've ever sampled.

The suspension has been changed at both ends from the baseline 900. Fork tubes are 2 mm larger in diameter (now 40 mm) and incorporate Kawasaki's Automatic Variable Damping System to increase damping rates as the fork compresses. The Uni-Trak rear end acts on the single shock absorber from both ends, Suzuki-style, instead of just from the bottom. Overall, the calibrations are softer and cover a wider range of adjustability. A 16-in. front wheel, as found on all the hot-rod Superbikes, makes for low-effort steering, and the 28° steering head angle does even more to reduce effort needed at the handlebars.

To Americans, more al-most always means better, but there's one item the Ninja 1000 has too much of—weight. At 560 pounds, it outweighs the 900 by over 30 pounds, and suffers so much by it that it won't quite crack the 10-second mark in the quarter mile. Top-end horsepower and super aerodynamics give it a ferocious terminal velocity, but buyers will have to vote with

their dollars for the lithe 900 or the supersonic 1000—tough choice!

Aluminum—and unstoppable

At a glance you can tell the Cannondale SM600 all-terrain bike is more than just tough looking. The knobby tires and black anodized 24-in. rear wheel improve traction when you attack the local version of Mount Everest. The bottom bracket and chainring are designed for maximum ground clearance. A decisively slanted top frame tube keeps you out of trouble if you suddenly have to straddle the frame. And the chainstays are very short, to prevent flex when you're standing on the pedals to fight your way uphill.

But more than anything, it's those large diameter frame members that stand out. What you can't see is that the whole frame has been fabricated from aluminum, but not entirely as a weight-cutting ploy.

Bicycle frames, you see, are subjected to a lot of flex as pedaling torque peaks, and that twists up the tubes a bit. The result is wasted energy going into that twisting action rather than the rear wheel where it would

(Please turn to page 50)



PHOTO BY BRUCE ALEXANDER

For those with leather lungs and steel legs, Cannondale's SM600 ATB is ready to carry you anywhere. Large tube aluminum frame with short chainstays is super-rigid.





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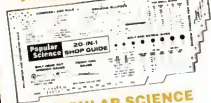
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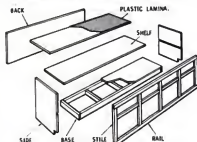
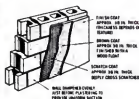
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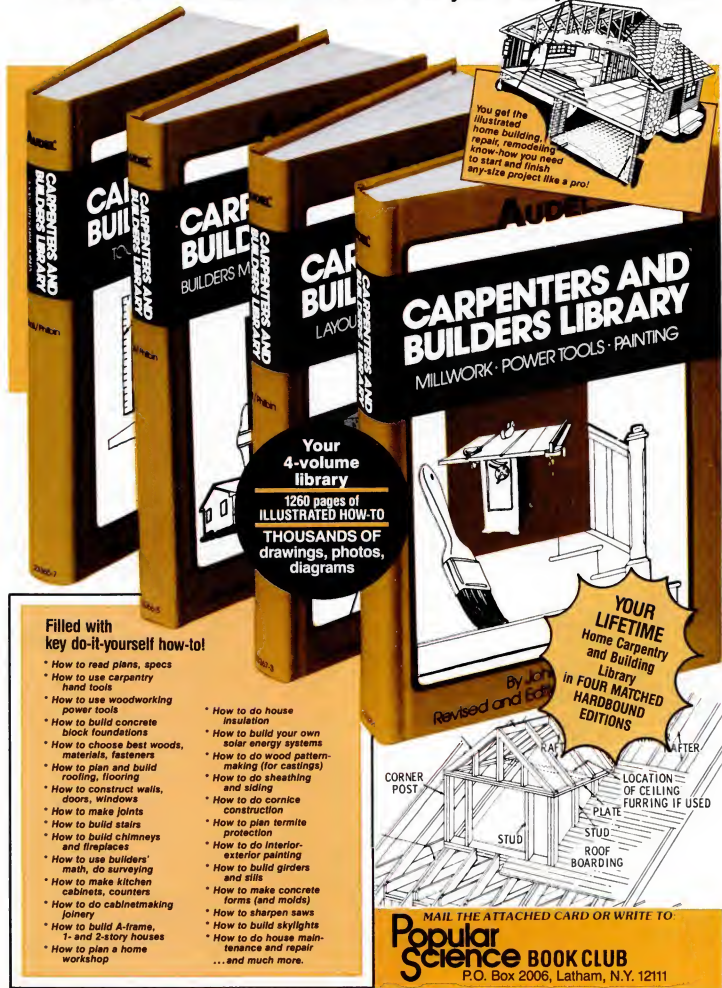
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CYCLES

(Continued from page 44)

help drive the bike forward. To increase the stiffness of their frames, the Cannondale folks relied on basic engineering principles. By increasing the tubing diameter to 1.75 in. from the more normal 1.1-in. dimension, they're able to double the relative torsion stiffness of their frames.

Were this frame to be built in large diameter steel tube, the bike would be an anchor. But by using 6061-T6 aluminum alloy, they end up with frames that average 3.75 pounds, about a half-pound lighter than most steel frames.

The aluminum frame will transmit less road shock than a steel one, so long rides are more comfortable. Cannondale has a trade-in program for owners whose bikes become damaged beyond use—\$150 plus your old frame gets you a fresh unit. New frames for the ATB enthusiast are \$295 including the front derailleur clamp, and the complete SM 600 goes for \$700.

Top-speed touring

There's no prize money at stake and precious little glory to be chased, so you might wonder why anyone in their right mind would bother to spend a week of their life in Wendover, Utah, at the

Bonneville Salt Flats. Valued only for its perfectly flat topography, Wendover is best known to westbound tourists as the last stop before the Nevada state border and slot machine heaven. But for another group, the diehard rodders, it's a simple case of an irresistible urge to find out how fast they go. Twelve miles or more of wide open salt



PHOTO BY DON GREEN

Turbo charged BMW with a passenger in the sidecar went 130-mph on the salt flats.

flats give them all the room they could want, though the 4000-foot local elevation does cut into an engine's horsepower potential by virtue of a slightly thinned out atmosphere.

After 37 years of running, Bonneville has fathered a cornucopia of classes that provide a land speed record niche

for anything from a V8-powered belly tank streamliner to a Jaguar engined highboy roadster. Everything has a classification, that is, except for a touring-type motorcycle sidecar rig.

That didn't stop Brian Casey of the BMW Motorrad dealership in St. Louis. He took a \$7000 BMW K100, attached a \$5300 EML Dutch-built sidecar and then sent it all off to Reeves Callaway in Connecticut for \$15,000 worth of turbocharger development work. The specially streamlined-for-Bonneville EML "chair" was definitely up to the job, but Casey and passenger Sam McRoberts added a roll cage, safety harness and fire extinguisher system for good measure.

After convincing the officials to allow them runs exceeding 100 mph, the 3-wheeler cooked to 124- and 128-mph speeds. Improving the aerodynamics by wadding a hotel room towel into the bike fairing's headlight recess and covering it with duct tape, they blasted out a 130.798 pass, fastest ever for a touring-style bike with a passenger aboard.

Do you think these guys were satisfied to prove their point and go back to Missouri with no land speed record but their legal limit of great stories? No way. They're already talking about returning later this year, and they've got 200 mph on their minds! **PM**

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One of the country's most respected research institutes reported applying a powerful ultrasonic cleaning process to a Slick 50 treated engine and was surprised at its performance. "We actually expected the Petrolon Slick 50 TFE Resin coating to also be removed, but later found it was still there."

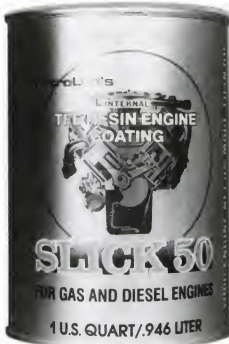
"Dune Buggies & Hot VWs" magazine April 1983 issue records the results of their one year testing of Slick 50. "We can indeed say scientifically that Slick 50 does work, and that it does reduce engine wear!... for the price of one treatment when compared to engine rebuild, we feel that you'd be money ahead using Slick 50."

The Federal Aviation Administration has fully accepted a similar product for aircraft—Slick 50 Aircraft Piston Engine Treatment (F.A.R. #33.49). This FAA endurance test simulated 1400 hours of engine use.

The senior engineering researcher at a leading southern California university stated, "Slick 50 does increase horsepower and decreases fuel consumption in tests done at the university."

The Space Shuttle Columbia uses the chemical "poly" in its gears and bearings because it is the only chemical lubricant which can withstand the heat and corrosive elements of space.

Perhaps most dramatic of all is a torture test overseen by the Automotive Services Council for Pennsylvania and shown on WTVE television. Three cars with 75,000 to 129,000 miles on them were treated with Slick 50. Six months later the oil was drained from each vehicle, and the cars driven without the oil plugs for about a half hour. The water temperature never rose and the engines sustained no apparent damage.



There isn't room here to tell you about the dozens of other tests proving that Slick 50 is everything we say. However, if you're still skeptical, send \$2.00 to cover printing and postage costs, and we'll send you detailed test results plus actual letters from users who report how Slick 50 saved their engines and saved them money!

It's Easy to Treat Your Engine

A few minutes before oil and filter change, add the engine flush you get free with each order to clean out the engine. Let the engine idle for 5 minutes. Then drain the oil, change the filter and add the proper amount of oil, less one quart. Add one quart of Slick 50, drive for 30 minutes, and leave it in the crankcase for at least 3,000 miles. As the engine operates, the oil carries the "poly" between the parts where it is burned into the pores of the metal.

Only One Treatment Necessary

It's permanent, so you do it only once, not each time you change oil. One quart of Slick 50 will treat all standard 4, 6 and 8-cylinder gasoline and diesel engines.

Works with Most Oils

Slick 50 will work with all petroleum-based oils and all synthetics compatible with petroleum-based oils with the exception of graphite oils. However, once an engine is treated, you can go back to a graphite type if desired.

4 Ways Slick 50 Saves You Money

Your actual percentages may vary depending on your driving, vehicle condition, weather and geographic location, but no matter what your conditions, Slick 50 can:

1. Increase mileage
2. Increase horsepower (small economy cars and large RV's really need this)

3. Reduce operating temperatures, thus increasing the lubrication and life of the oil and engine

4. Minimize or eliminate costly overhauls by reducing engine wear

Up to 90% of the engine wear on a car can be caused by lubrication starvation cars experience when first started before the oil begins to circulate. Slick 50 can eliminate this problem for less than the cost of two tanks of gas.

Slick 50 Will Not Affect Your Warranty

Slick 50 is suspended in an excellent grade of petroleum oil which meets or exceeds every manufacturer's engine warranty requirements. In addition, this oil carries an American Petroleum Institute service classification SF-CC-CD.

There's No Risk with Our Money Back Guarantee

Use Slick 50 for 3000 miles. If you don't notice an improvement in engine performance, return your invoice with a short note telling why, for a prompt full refund — no questions asked.

Profit from Selling Slick 50 Yourself

Here's an opportunity to make handsome profits. Having such solid test results from major institutions make Slick 50 easier to sell than many other products. Free dealership information is sent upon request.

Free engine flush sent with each order. Free shipping with orders of 2 or more.

For purchase or further information call toll-free 1-800-525-8624, ext. 2 (in Colorado call 1-303-762-1385) or send to: Progressive Energy Corp., 3148 South York Street, Dept. PM286, Englewood, Colorado 80110.

Yes, I want to improve my car's performance and save my engine — rush me risk free

☐ One Slick 50 at \$39.95 + \$4.00 shipping and handling.

☐ Give me free shipping and handling for my order of 2 or more at \$39.95 each.

☐ Check ☐ C.O.D. ☐ Visa/MasterCard

Card # _____

Exp. Date _____

Name _____

Address _____
(Give street address if possible for UPS delivery)

City _____ State _____ Zip _____

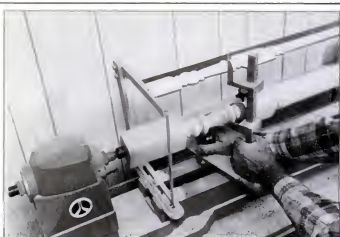
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Tool Tests



Lathe offset duplicator

Turning a spindle on a lathe is a fairly easy operation. But making exact copies of the first leg to complete a set is much more difficult. With this tool you can dispense with the fuss of measuring, marking, checking and double-checking.

The Offset Duplicator consists of a support base and

post from which a tracing stylus and cutting bit project. Two brackets attach to the lathe bed and hold the work that is being copied. As the stylus is moved to follow the contour of the sample, the cutter follows the same contour on the blank.

The original or sample can be either a turning or a flat

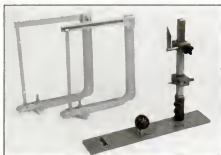
Cutting bit follows stylus against the template. Toolpost base slides along the ways of the lathe. Both stylus and bit are adjustable, so you can turn spindles of different diameter than the original.

contoured template cut from a strip of hardboard. I tried the tool using a flat template, working on a 3-inch square oak blank.

On my first attempt, I broke off the tip of the cutting bit and splintered the corners at the shoulder of the blank. The cutting point was easily reground, howev-

er, and by turning the lathe at high speed and feeding the cutting point slowly into the blank, I was able to make a perfectly clean cut. The contours in the workpiece matched those in the template exactly. Write Turn-O-Carve Tool Co., Box 8315, Tampa, FL 33674.

—Rosario Capotosto



Offset duplicator consists of support base with cutter bit and tracing stylus; two brackets support piece being duplicated.



A turning can be used as a template or, as shown, a flat template may be made by gluing a paper outline to hardboard.



Cut the template shape on a scroll saw, following the paper outline. Mount template on the lathe brackets, as shown above.

Self-lighting torchgun

The BernzOmatic pistol-grip torchgun is a lightweight, easy-to-handle unit with some very convenient features. A pull-on trigger fires it up instantly through the action of a piezoelectric igniter, housed in the impact-resistant plastic case. The torch requires no matches, sparkers, batteries or other lighting devices.

A 4-ft. hose connects to the fuel cylinder so you can carry the cylinder comfortably on your hip in a belt clip. A holster tube attaches to the cylinder to store the torch conveniently at your



Pistol torch with 4-ft.-long hose ignites automatically when trigger is pressed. Regulating knob atop propane cylinder controls flame size. Belt clip maintains constant fuel pressure. Belt clip snaps over cylinder neck.



side when not in use. The solid brass regulating valve maintains constant fuel pressure with the torch held in any position, and when used at very low temperatures.

Called the Pistol Panther, by BernzOmatic, Medina, NY 14103, the torchgun is sold at home centers and building supply outlets. Suggested retail price is \$49.95.

—Rosario Capotosto

STOP SMOKING IN 1½ HOUR FLAT

Even Though You Really Don't Want To Quit!



That was me. A pigheaded, "didn't want to quit", die-hard smoker. Trapped in an aggravating love-affair—with cigarettes.

Openly, I cursed their choking grip on me. Inwardly, I was totally unwilling to do anything else but puff away. Your typical chain-smoker wildly raving about kicking the habit—and not meaning one single word.

It was a joke. Unfortunately, the laugh was on me. The grim warnings of the Surgeon General, the American Cancer Society, and my worried doctor all went in one ear and out the other. My tobacco addiction was like a runaway train. Completely out of control and destined for disaster. *Unstoppable!*

**Me give up smoking?
Better ask for my right arm!**

Every so often, I would make a good old college try at quitting cold turkey. Before you could say "Jack Robinson", there I'd be. Frantically scrounging in the garbage for soggy butts. As usual, my good intentions went up in smoke. I was hooked—again.

Who was I kidding? Smoking was an undeniable necessity. Super-important to my daily life. How I enjoyed that first eye-opening drag in the morning—that satisfying end-of-the-meal lighting up—that nerve-settling inhalation when things got hectic. Me give up all these irreplaceable pleasures? Better ask for my right arm!

Cancer or no cancer, doctor or no doctor, I loved smoking much too much to ever stop. But one day, I discovered a secret that turned my burning passion into red-hot hate. A secret that set me free in just 30 minutes flat. *Not a single cigarette in 20 years!*

**Freed me in 30 minutes!
Not a cigarette in 20 years!**

My smoking is past-history. Gone without hypnosis, behavior modification, pills, drugs, classroom courses, nail-biting, will-power or climbing the walls. Gone without such games as switching brands, chewing gum, fake candy, diary-keeping or saving dirty stubs in a messy jar.

Gone, too, without gaining an extra ounce. Matter of fact, my wife says that I even lost a couple of pounds. And I never felt better.

Running into an old buddy brought back memories of those "didn't want to quit" days. This 3-packs-a-dayer had tried everything but still couldn't stop. He begged me to outline the details of my remarkable secret.

That night, I wrote it out in plain, step-by-step language anyone could understand and mailed him a copy. After it did the trick for my buddy, he told some of his friends. Soon, I was hunted out by pleading strangers for the same "Stop Smoking Secret."

If you can lick a stamp, you can lick your cigarette habit just as I—and they—did. I know what it's like to have that compelling urge to light up. And I know what it's like to be able to smilingly pass it by without pangs of yearning.

What's more, I know that you can honestly and truly stop smoking for keeps in half an hour flat—even if it's the last thing in the world you'd rather do. All for a ten dollar bill.

Simply send for my "Stop Smoking Secret" and read it. Yes, it's as easy as that. Just read it. I can't tell how it works. It just *does*. I guarantee it, with no strings attached.

**Guaranteed to work—
or your next pack's on me!**

If you ever start smoking again after reading my secret—and I mean *ever*—you haven't lost any money. Merely return it for a full, every-penny-back refund plus \$1 extra for a pack of cigarettes! *My treat!*

OK. I know exactly what's running through your mind. Even with my fool-proof, risk-free, money-back plus guarantee, you're still looking for a way to get out of sending for my secret. You can't fool me. It's not the money. You'll pocket 100 times your investment in cigarette savings alone. The bottom line is this: You really don't want to quit—and *you'll do anything to avoid it.*

But just this once, listen to that little voice inside your head. Just this once give in to your common sense and give my secret a "look." Watch it automatically work for you in the only way that counts. Permanent no smoking! *Or your next pack's on me!*

**Stop Smoking Co.,
49 West 37th St., Dept. SS-97
New York, N.Y. 10018**

OK—I'll take a risk-free look. Here's my \$10. Rush the "Stop Smoking Secret." If I ever start smoking again, I can return it for \$11 refund. (That's \$10 back plus \$1 extra for a pack of cigarettes—**GUARANTEED!**)

Name _____
Address _____
City _____
State _____ Zip _____

Electronics



BY STEPHEN A. BOOTH

New from Japan



No—it's not a masquerade party. These are prototypes of the electronic eyeglasses used to watch 3-D videodisc programs.

TOKYO—In an ancient mountaintop shrine near Kyoto resides the unlikely statue of America's own Thomas Edison. Edison, you see, discovered that bamboo from Mount Otoko made the ideal filament for his early incandescent lightbulb. It was fitting, then, that a tribute to Edison at the shrine coincided with last October's mammoth electronics fairs here and in Osaka, which kick off the new model year for hi-fi, video and related gear.

Edison didn't discover electricity, but he invented ways of using it that enrich our lives today and inspire the many innovations displayed at the fairs by Japan's electronics manufacturers.

The annual Tokyo and Osaka shows overflow with more new consumer elec-

tronics products than one column can do justice to. Accordingly, let's focus on some emerging technologies which, though not for sale today, should arrive on our doorsteps before long. For the latest scoops on technologies already here, stay tuned to our regular monthly

columns on audio, computers and video. Suffice it to say that in audio, the Compact Disc player continues to come down in size and price, and is finding its way into more automotive and portable applications. A close cousin, the digital audio cassette, should arrive on these shores by year-end. So will amplifiers that process the signal digitally, all the way to the speaker leads. These amps, and other components, will swap copper wiring for fiber-optic cables.

Digital's coming to video too, in the form of memory that provides clear and steady freeze-frame effects—even pictures within pictures.

On this note, perhaps the most intriguing new technology at the shows was an old one—3-D, but for videodisc. Sharp and JVC developed the system, which uses the VHD videodisc format available in Japan but not here. Two cameras are used to form one image for the left eye and one for the right. These images are recorded alternately on the disc. Special liquid-crystal eyeglasses, synchronized to the disc tracks, act as high-speed shutters so that each eye sees only the image intended for it. The brain then combines the images to form a 3-dimensional picture. JVC says it hopes to offer the system in Japan this year. A 3-D disc will cost about \$23. The glasses and 3-D adapter (needed for an under-\$500 VHD player) cost \$200.

It's possible that those 3-D images will be viewed on a flat, wall-mounted TV be-



The lady and the tiger? Feline image was printed from TV with electronic photography system.

fore long. Toshiba, Casio, Seiko-Epson and others showed work-in-progress on their liquid-crystal display screens ranging from 10 to 13 in. diagonals. Though the pictures were brighter and the colors sharper than LCDs we've seen before, it'll still be five or more years before they can match the quality of cathode ray tubes.

By the time that happens, at least some of us will be



Flat LCD color TV is suitable for mounting—but not yet. Tube-type image quality's 5 years off.



Measuring 2 x 3 feet, the oval antenna-dishes sold in Japan for satellite TV are small in comparison to U.S. standards.

receiving TV on a small, 2-ft. antenna dish via direct broadcast satellite (DBS). The service, in limited form, exists in Japan today—and nearly every manufacturer sells equipment for it.

From DBS or plain old broadcast, you'll be making still photos off your TV soon. Everyone in Japan is showing color printers for Electronic Still Photography. Video columnist Jim Meigs will tell you about Kodak's system next month. **PM**

There's a new truck on the road.

It doesn't happen very often. A new Jeep pickup. When your name is legendary, you take the time to be certain that the legend lives on. We're quite certain about Comanche.

2WD/4WD.

Comanche is available as a 2-wheel drive or 4-wheel drive model with a choice of two "shift-on-the-fly" 4WD systems.

Suspension.

Comanche's exclusive Quadra-Link suspension, dual-action shock absorbers, and stan-

dard 15-inch all-weather radials are specially tuned for exceptional ride and handling.

Power.

Comanche comes with either a 2.5 litre electronic fuel-injected four, an optional 2.8 litre V-6, or an optional 2.1 litre inter-cooled turbo-diesel.

Interior.

Comanche's interior is every bit as sporty, stylish, and contemporary as

payload, base engine horsepower, 4WD systems, wheels and tires... the list goes on and on.

It's called Comanche.



It's built by Jeep.

the rest of the truck. Many find it hard to believe it was designed for a pickup.

The Exclusives.

Jeep Comanche was built to be the best in its class.* In optional 4WD

The Bottom Line.

Just how affordable is Comanche? It's the lowest priced Jeep available today. You'll also find something in Comanche you won't find in any other pickup anywhere. The Jeep legend.

It's worth a look.

Only in a Jeep

Safety belts save lives.

*Comparisons based on competitors' 1985 model information.



Comanche
XLS

Inside Detroit



BY JIM DUNNE

Chrysler's 'Monte-Bird'



The '87 J-car Chrysler will compete with the Monte Carlo and T-Bird.

Chrysler has another convertible in the works. And Dodge, too. Look for the new J-cars from Chrysler to get a convertible model within six months after their late-1986 introduction. The J-cars are 2-door, notchback, personal luxury cars that will compete with Thunderbirds and Monte Carlos. But with the soft tops, the J-cars will have an exclusive body style in their class. Look for Chrysler to drop the convertible from its LeBaron and 600 series when the two new models show up. This will keep three convertibles in Chrysler's lineup, including the Maserati-built, luxury 2-seater.

Cadillac gives up

After four years of hearing criticism that the Cimarron looks too much like GM's other J-cars—Cavalier, Sunbird, Skyhawk, Firenزه—Cadillac decided to make a switch. The plan is to drop the U.S.-made Cimarron for 1987, and bring in a compact luxury car from Opel of Germany in its place. One guess is that the car will be the Monza, a pricey—\$15,000 to

\$20,000—2-door hatchback that will go 135 mph and compete with Porsches, BMWs and Merkurs. With this change, Cadillac will have an exclusive among GM divisions, and a car that looks different from anything that GM produces in this country.

Those Lincoln ads on TV that make fun of the look-alike styling of DeVilles, 98s and Electras also hit a sore spot at Cadillac. "We have exclusive sheetmetal on DeVille," a Caddie executive complains, "but we aren't getting our money's worth. The Buick and Olds styling is too close to ours." It takes time to change styling, but you can bet that GM designers are working overtime to alter the roof profile, at least, of the big C-body cars. Look for grilles—a car's most prominent identification feature—to be bolder and show stronger differences between GM brands in the very close future.

AMC's Imports

There's brave talk from Comanche country. American Motors will bring in three

new models from Renault in the next two years. The lineup includes a GT sports car and two sedans, one in the low-price end of the market, the other a compact. "Renault is committed to staying with American Motors," says AMC Chairman Jose Dedeurwaerder. "We will import from Renault (in France), import from Taiwan or build here to meet what the competition does."

AMC is proud of what its Jeep products are doing in the market. Cherokee is a huge success, and Comanche looks like it will be strong as well. And the new Jeep promises to increase sales in the 4-wheel-drive market this year.

The company is disappointed with sales of its mainline sedans, Alliance and Encore, but officials believe that quality improvements will turn around sales of these models as well.

Fwd Lincoln prototype

Following the aero theme of the Taurus is this prototype of the 1988 Lincoln Continental (below).

The body styling of the two cars is so similar that only the grill design is easily seen as distinctive. For these early test cars, the Lincoln uses the front end of the current Mark VII.

While the body does resemble the Taurus in general shape, it is bigger, wider and has slightly different angles

Reatta shows its face

Security for the Reatta 2-seat sports car that Buick is set to bring out as a 1988 model is hit and miss. Up to now, only pictures of the



Buick's 2-seat 1988 Reatta has a smooth nose with pop-up lights.

rear or side have been taken. But this view finally shows the front end. It appears that Buick uses a little of the Skyhawk Limited, a dash of the Porsche 944 and a bit of an original shape in styling the front end. Headlights are hidden, a built-in air dam is standard and bumpers are integrated into the body panels. All-steel body and front-wheel drive separate this \$20,000-plus hardtop from the plastic-bodied Corvette and Fiero. Buick's most powerful 3.8-liter V6 engine will place Reatta only a tick behind the Corvette in performance. Look for Buick to avoid Corvette's bedrock performance buyers and cater to the country-club set with this luxury model.

MAP it out

Here's one you never thought of. Most of the com-



The '88 Lincoln Continental will look like a Ford Taurus, only bigger.

puter systems used throughout an automobile company won't talk to each other. That's because, in a company like GM, each office and each factory buys computers to fill its own needs. The plant manager may use a dozen different computer systems to run his robots and inspect

(Please turn to page 60)

FREE high tech catalog



Most Accurate Clock uses NBS atomic clock signal to keep "perfect" UTC time.



"Smart" metal locator homes-in on precious metals, disregards junk.



Build IBM-PC compatible Heathkit computer and save, or buy assembled.

Computerized weather station "remembers" weather to aid in forecasting.



Robotics technology comes to life in building HERO[®] I and teaching it movement, speech, and manipulation.



World's first low-cost hand-held, microprocessor-controlled Real Time Spectrum Analyzer.



Hams! Get the latest in amateur radio technology including high-speed Packet Radio Communication.



Precision test instruments speed troubleshooting.



New Digital Rain Gauge records rainfall accurately and reads out inside your home in 100ths of an inch.

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Gillette Research presents a revolutionary shaving concentrate and brush in one.

BRUSH PLUS! FOR A SUPERIOR SHAVE.

Brush Plus. A brush to lift your whiskers with the soothing warmth only a brush can give you. A concentrate with extra softeners and lubricants that are massaged deep into your beard. For a superior shave. Twist the dial to send just enough concentrate into the brush, so each refill cartridge can deliver months of noticeably superior shaves. Brush Plus from Gillette. Refills in Regular, Lime, Sensitive Skin.



© 1984, The Gillette Company

INSIDE DETROIT

(Continued from page 56)

tion machines. In the front office, the accounting department's computers are different from those on the secretaries' and engineers' desks.

"Our factory offices can't talk to robots out back, and that's not right," is the complaint you hear. Well, GM management is listening. Together with a couple dozen other manufacturers, including Boeing, GM is setting up standards for computers that will allow direct communication between brands. The program is called MAP, for Manu-

facturing Automation Protocol.

Ultimately, personal computers in GM's offices will be able to tie into any other appropriate machine in the company. Right now, there are dead ends just about every time electronic information is passed from one brand of computer to another. The computer firms, in their early efforts to set up exclusive use of their products, paid no attention to this problem. But GM and others are forcing common standards on them to make sense out of this mess.

How low can Yugo?

The price is the most important feature

of the new import from Yugoslavia, according to a couple of executives from Ford and Toyota. Asked what he thought of the \$3990 sticker on the Yugo, Ford President Harold "Red" Poling said, "I was shocked." Dave Illingworth, head of Toyota's midwest region, who had more time to assess the price threat, sneered, "You get what you pay for." It will be interesting to hear what Yugo executives have to say about a future competitor, the Czechoslovakian Skoda. It now sells in Canada for 4995 Canadian dollars, and could sell here in 1988 for as low as \$3600.

What rich folks get

Audi, a company that admittedly does not produce cars "for the masses," went overboard in designing the 1986 5000S line. In addition to 4-wheel drive, anti-lock braking, and a more powerful intercooled, turbocharged engine on some models, all 5000s use 2-sided galvanized steel throughout the body panels. Fenders, hoods and even the roofs have zinc protection. Audi now has a 6-year unlimited mileage warranty against rust perforation. Fine, but who needs galvanized coating on the inside of a roof? Audi officials admit this is going a bit far, but they predict their competitors will do the same soon. Besides, it's easier to build the whole body with one type of steel than to use a different steel for one part like the roof.

Ford in the future

Ford's T-2008 project is a look at the car that you may see in showrooms 25



The Ford T-2008 is a 21st century 4-seater.

years from now. The project brings together ideas from eight of Ford's divisions—glass, electronics, plastics and so on. Styling of the prototype T-2008 is predictably sleek, smooth and aerodynamic.

Among the other standout features are: TV cameras that take the place of rear-view mirrors. These are equipped with sensors that see in the night or through fog. Door locks automatically open when a code is pushed on the glass. If unlocked, a single number code opens the door automatically. One-piece wheels and tires made of plastic are perfectly balanced. A glass-like roof darkens in sunshine just like some sunglasses do. In addition, a stranded driver can contact dealer help in an emergency by communicating through a Ford space satellite! **PM**

HOW TO UNLEASH YOUR MIND-POWER TO ACHIEVE ALL YOUR GOALS FASTER.

Subliminal Stimulation™ is Today's Answer. It's NEW!

You've read in science and technical magazines about the great success of **subliminal stimulation™** techniques. Now, thanks to recent breakthroughs by leading scientists, you can use these same innovative techniques to step up your accomplishments and unleash your mind-power!

For example, maybe you want to sharpen your memory. This is really important when you're working on your car or building things around the house. There are so many steps to remember. Or maybe you need to lose weight, stop smoking or hone your mental skills. Just think how great it would be to grab money-making opportunities by drawing on your mental capabilities to the maximum extent. Or maybe you want to lessen stress, have greater self-esteem and razor-sharp decisiveness. These are just a few of the accomplishments now easily within your grasp.

The subconscious or "inner mind" is a mysterious thing. Scientists are finding out more about it every year. It's not like your conscious mind. Instead it soaks up impressions. You'll be amazed how fast the "success-mechanism" already within you will put you ahead of the game in life.

Subliminal Techniques are men's problem solvers for the 1980's and beyond.

Subliminal stimulation is a remarkable scientific discovery. For example, to reduce shoplifting. Department store managers nationwide are finding that a "hidden" message in the public-address music cuts pilferage substantially. This message repeats over and over such tested phrases as "I am honest. I don't steal."

Talk about effective! Customers aren't even aware of it. Yet inventory statistics prove there's a big decrease in shoplifting. In fact, in some cases by as much as 67 percent.

Your subconscious is powerful. Put it to work to bring you success fast. Thousands of men already are.

Until recently, scientists were stopped dead in their tracks in figuring out how to harness the powers of the inner mind. For years we've known it could be tapped. But the big question was: "How can the average man put his huge power to work?"

Through constant testing a breakthrough finally came. The credit goes to some of the top scientists in the country. Their hard-hitting efforts now enable you to push ahead, no matter your goals, and enjoy tremendous success fast.

The answer is Subliminal Stimulation Tapes. Each brings you two different kinds of assistance.

Put a tape on your regular cassette player—then get ready for a surprise. On one side is **subliminal stimulation™**. Here's how it works: You hear waves breaking on a rugged

shoreline. But your subconscious hears more. There are subliminally embedded messages at work—literally hundreds. Now you'll have a hard time hearing them consciously. But your subconscious will hear them as clear as a bell. Scientists have found the subconscious then goes into gear at once.

Listen while you work around the house or while relaxing, watching TV or even while jogging, working out, or driving your car. The sounds of the waves make a smooth background while alone or with your family or friends.

Subliminal stimulation is so effective it's being featured in scientific and technical journals. Just wait until you try it! It's a totally new, yet natural, experience. You'll feel at home with it fast. A to-the-point briefing on each tape gives you the exact wording of the subliminal messages coming up. It's really fascinating and worry-free.

Now, on the other side you'll hear a voice. This is called the **natural response™** program. You'll hear "commands to your subconscious." Think what it will mean to actually be in control of your subconscious. At last, you'll be showing it who's boss!

Be a part of the cutting edge of today's world of science.

Here's your opportunity to discover a sure-fire way to achieve all your goals—no matter what they are—in record-breaking time. You'll feel more alive, more virile and see success after success come your way. Taking advantage of new scientific discoveries puts you one step ahead of the crowd.

Professionals nationwide are finding Subliminal Stimulation Tapes to be one of the biggest scientific breakthroughs of the 80's. Each side actually wakes up your inner mind. Result? You'll see yourself becoming sharper, more "in charge" than ever. You'll get more done faster. And the great part is, each side is so relaxing you'll want to listen time and time again.

Don't let your subconscious lay idle. Put it to work. Scientific-minded men everywhere are—with outstanding success.

Order today. Read about this Special Money-Saving Offer:

Each Subliminal Stimulation™ Cassette sells for \$14.95. But during this **Special Introductory Offer to Popular Mechanics** readers, the price is only \$9.95. You save \$5.00 on each and every selection.

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Audio

BY TERRY SHEA



Hands-on report: Pioneer CD changer

The digital Compact Disc is proving itself an increasingly versatile performer. Several manufacturers soon will join Sony and Technics in offering portable CD players. More car stereo CD units are on the way. And by the time you read this, Pioneer will serve up a multiplex home model that can handle up to six discs at a time.

The Pioneer CD changer, Model PD-M6, is a modern-day equivalent of yesterday's record changer, a much-maligned device (unjustly, in many cases) that

sonable approach with its XR-V22 (\$500), which has two laser transports to handle two discs. JVC will soon offer a similar model.

But Pioneer seems to have settled upon a logical compromise between the overkill of the Nikko machine and the stinginess of the Toshiba and JVC units. Why six discs? Why not six? The changer's continuous music capability should be enough to last through the most languid of dinner parties or to satisfy fans of marathon listening sessions. It also



Pioneer's PD-M6 changer: Magazines (left) hold six discs.

offered enormous convenience—even if many low-quality models handled your cherished LPs about as delicately as Hulk Hogan handles Mr. T.

Pioneer claims that the PD-M6 is the first multiplex CD home unit, but that point is arguable.

Nikko, for example, offers a CD changer (Model NCD-600) that handles 60 discs and is rather large. It's ideal for commercial use, and you can buy one for your home if you like, but at \$1800 it's hardly for everyone.

Toshiba offers a more rea-

seems to strike a nice compromise between disc capacity and player size, as the PD-M6 is no larger than many single-disc players (it stands 3 1/4 inches high). What's more, it's reasonably priced, with a suggested retail sticker of \$499.95.

The Pioneer changer uses a disc "magazine," or cartridge, into which the six discs are loaded. Then, the entire magazine is inserted into a front panel slot. Separate trays in the magazine hold each disc and loading them is easy enough, though sometimes it's tough to tell

which tray has been loaded as you work your way through the six. Pioneer suggests using the magazine for permanent disc storage, and so offers extra magazines at a suggested retail price of \$9.95 each. The company says it's developing an automobile CD player that would use the same magazine, in which case storing your CDs in the magazine would make sense.

Using a preproduction prototype PD-M6, I discovered that the changer is rather straightforward in its operation. If all you want to do is play your six discs, it's simply a matter of turning on the player, inserting the magazine and pushing PLAY. The PD-M6 will start at the first track of the first disc and play through all six.

There are three other basic playback options: direct playback of a specific disc and/or track, programmed play of selected discs and tracks, and what Pioneer calls random play.

Direct playback is a breeze. On the front panel are six buttons. Simply hit the desired disc number, the track number and PLAY and you're in business.

Programmed play is just as simple: Push the disc and track number you'd like to hear first, then the PGM MEMORY key. Repeat that for each selection you'd like to hear. You can program the machine to play up to 32 tracks from among the six discs, in any desired order. To help out in the programming process, the display keeps track of the number of selections you've committed to memory so you know when you're nearing the 32 maximum. Press the CHECK key and the display takes you through what you've already programmed.

The changer's display is a fairly versatile one, normally showing you the disc number in play, the elapsed time of the track in play and the track number. At the punch of a button, it will change to show total playing time of the disc in use and the total number of tracks on that

disc. Push that same button a second time and you get the disc and track number in play. Meanwhile, there is a separate display that always indicates which disc is playing. It can be a bit difficult to read from across a room, but fortunately the number of the playing disc appears in red while the other five positions are in blue, so even if you can't read the digit you can count across and determine which disc is playing.

Finally, in random play, the player decides for itself in what order tracks will be played, selecting from among all six discs. The order of play is different each



Toshiba's XR-V22 plays two CDs, stored in transports A and B.

time you select random play—perfect if you want to bring a bit of suspense to your music listening.

Other features of the PD-M6 include MANUAL SEARCH keys for fast forward or fast reverse searching through a disc, and TRACK SEARCH, which advances directly to the next track or backward to the beginning of the track that's in play. Repeated pressing of either of these keys takes you farther forward or backward, track by track.

Perhaps the only criticism that can be levelled against the PD-M6 is that in the prototype I had, disc changing was accompanied by a great deal of whirring and clicking. A Pioneer spokesman says that the factory is well aware of the noise, and assures me that production models will be much quieter in operation. I hope so, because all that mechanical clatter is decidedly low-tech in a product that is supposed to be a technological marvel. Then again, it's difficult to decide what's more annoying—a bit of noise as the discs are pulled in and out of the magazine, or having to get up every 40 minutes or so to change the discs. **PM**

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Let me show you how you can make a minimum of \$8,000 in 2 days. That's right! In only 2 days you could be enjoying a completely different and wonderful lifestyle!

Can you use \$8,000 in the next 2 days? Can you use \$16,000 in the next 2 weeks? Can you use \$24,000 in the next 30 days? This is an absolute reality and I want to show you how it can be done.

There was a time when I was so broke I could not put diapers on my baby or feed my family. Maybe you are living like I was — I pray that you are not. Maybe you are hurting financially just a little. Maybe you are thousands of dollars in debt and can't see your way out, or maybe you are just dissatisfied with your present way of life. If any of the above applies, you will be interested in what I have to say!

I am on top of the world — but it wasn't always that way; in fact, 13 months ago, I was hurting and hurting badly. Almost 2 years ago I got involved in a business that turned out to be a disaster. Unfortunately, when it went down the tubes, all my life savings went with it. I thought my life had come to an end. I had no money to pay the rent, the car payment, the phone bill, the gas bill nor the light bill. That's right, I didn't have a penny to my name. The thing that was really bad, was that my family was suffering with me.

In a matter of 9 months, we were \$14,000 in debt. We had a place to live only because a friend was kind enough to let us stay rent free. Life was bad, and every day it was getting worse. Despite the disappointments of being in debt and unemployed, we kept hanging in there — looking and searching for something — anything!

This might sound like a familiar song to a few of you, but in my situation, the results were rare. In one miraculous day, everything changed. That particular day, I woke up very early. I went into the kitchen, set down and dropped my head to the table. I was so miserable and full of hurt and grief watching the hours pass by. All of a sudden, I was overcome with an incredible idea: an idea that was so strong, I instantly picked up the phone. I made that one certain phone call. Just one phone call and 2 days later, we were making \$8,000 a month guaranteed! All I made was one phone call and in 2 days our miseries were gone!

In the next 60 days, we paid off our \$14,000 debt and began buying things that even people who have worked all of their lives can't afford: my dream car — a Mercedes 450 SL. It was a symbol of my small discovery and my victory over defeat.

Five months after this discovery, I bought my wife a BMW 533i for Valentine's Day. It was just a little something to let her know how much I appreciated and loved her for sticking with me through those trying 9 months.

Eight months after my discovery, I asked my wife where she would like to live if given the freedom and the choice: "California." So we packed up everything and moved to the most beautiful spot in the state. Those of you who have been to Santa Barbara know what I'm talking about. We moved to a beautiful \$250,000 home right by the ocean. And we still had \$30,000 in the bank!

Yes, our lives changed entirely in only 2 days — all because of one, simple phone call — a phone call that anyone, anywhere can make. All you need is to know the secret. This is such a great little secret, I just had to write a simple book telling you how to make the ONE, SIMPLE 3 MINUTE PHONE CALL. This call will entirely change your financial picture in only 2 days, as I did mine.

Believe me, it works — it works big — and it keeps on working. Day after day, week after week, month after month — it keeps on working for as long

as you want it — guaranteed!

My money making method is so simple that it is almost hard to believe. Just imagine, you are sitting by your phone and you make one phone call that takes approximately 3 minutes. In a maximum of 2 days, you can be making a minimum of \$8,000 per month, guaranteed, for as long as you want it. Pick up the phone again, and make another 3 minute phone call and in 2 days, you can be making a minimum of \$16,000 per month, guaranteed, for as long as you want it.

THE FORMULA WORKS LIKE THIS: EVERY 3 MINUTE PHONE CALL = \$8,000 PER MONTH INCOME GUARANTEED FOR AS LONG AS YOU WANT IT.

There is nothing magical about this. You just need to know who to call. It's that simple.

Every successful person has his secret to success. But some are harder to follow than others. I know that my secret is by far the easiest. How difficult can it be to make a 3 minute phone call — which can be making you \$8,000 per month in just 2 days. YOU JUDGE FOR YOURSELF.

I promise, there is NO CATCH. You just need to know who to call.

My program is something that has never been done, seen nor advertised before!

I don't want to waste valuable space telling you what it is not, but I guarantee you that you have never seen anything like this before. Although you make a 3 minute phone call, you do not sell anything over the phone. I repeat, YOU DON'T SELL ANYTHING.

My program is absolutely legal and the most moral and ethical work you will ever do.

This is something anybody, living anywhere, in any kind of circumstance can do.

Sworn Testimonial:

"After receiving Doug Holmes' book, it took me two days to secure an income of \$12,000 per month guaranteed, for as long as I wanted it." Mika Kohler, Texas

Sworn Testimonial:

"I'm 32 years old, high school education and a housewife. Once receiving Doug Holmes' book, within a few days I secured enough income to become financially independent for life." Karen Skelly, Illinois

Sworn Testimonial:

"I was flat broke when I received Mr. Holmes' book. After 2 days of applying his method, I locked in an income of \$8,400 per month guaranteed!" Dan Cockrell, Texas

Sworn Statement:

"I have personally been a witness and do testify that Mr. Douglas G. Holmes has been able to secure in 2 days \$8,000 per month, guaranteed — after one 3-minute phone call." Mitt F., S.L.C., Utah

Sworn Statement:

"As the personal accountant and brother of Doug Holmes, I testify that Mr. Holmes has, indeed, been able to lock in an income of \$8,000 per month, guaranteed, within a 2 day period. I also testify that the statements made on this page are accurate and true." Robert M. Holmes, Accountant Oregon



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Order my book "Zero to \$8,000 in 2 Days" and let me prove that what I have said is true. When the book arrives, quickly open it to the first page — take the next 60 minutes and read my seven simple steps to success. Then pick up the phone and make that 3-minute phone call, and if you are not making a minimum of \$8,000 per month, guaranteed, within 2 days, send back the materials in original condition at anytime for a full refund.

Make \$24,000 in 30 days or \$16,000 in 14 days. If you have any doubts simply order the book. With my guarantee you will be trying my program absolutely free. You have nothing to lose and \$8,000 in 2 days to gain!

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Your Order Form

Douglas G. Holmes
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Santa Barbara, CA 93111
Dear Doug,

If you can make one 3-minute phone call, then surely I can. I'm willing to send you \$10 on the condition that if I'm not making \$8,000 in 2 days, or am not satisfied with your book, I can send it back at anytime for a full refund.

Option ☐ \$2 Special handling and 1st class shipping.

Name _____

Address _____

City _____

State _____ Zip _____

Foreign orders, please add \$2 for shipping.

Thank you! _____ c 1985

Car Clinic

BY MORT SCHULTZ



Caddy's HT4100 engine

I received a letter from Cadillac informing owners of 1985 models with 4.1-liter V8 (HT4100) engines that coolant may leak into the crankcase and dilute engine oil. The repair involves changing oil, oil filter and coolant, and adding an engine coolant supplement (sealant). True, Cadillac has extended the warranty on the engine to 48 months or 50,000 miles, whichever occurs first, but the questions that are left unanswered are bothersome. I'd appreciate it, as I'm sure other Caddy owners will, if you would find out everything and anything you can about the matter.

CHUCK TOLAND
FORT SALONGA, NY

The condition the Cadillac letter addresses involves early 1985 models with the 4.1-liter engine, and all models from 1982 through 1985 that have this engine. A spokesman for the company told me the number of engines that may develop a leak are quite small, but Cadillac can't identify those that may and those that won't—so the company decided to treat all of them.

Cars that are primarily susceptible to coolant leak problems are ones engaged in short-trip driving (less than half an hour) in cold weather. The leak may develop because of a differential in thermal coefficients between the aluminum engine block and iron cylinder. People who disregard the

notice—especially those living in Florida, Arizona and other all-year-round summery places who think they don't have to worry—better be aware of the possible consequences. If a leak does develop and goes untreated, coolant will contaminate engine oil. Oil will lose lubricity, possibly resulting in premature failure of camshaft lobes, rocker arms,

pushrods, distributor gears and other parts. When a leak develops and one of the above parts is affected, the head gasket seal may fail, causing a noticeable drop in the power output of the engine, and the engine may idle roughly.

You know me well enough to appreciate that I don't act as an apologist for any car company, but fair is fair. Some letters other than yours I've received about this situation have had some unjustifiably nasty things to say about Cadillac. One reader, for example, asked about "this wonder pill Cadillac wants to drop into my radiator. Isn't this just a put-on?"

No, it's not. The compound Cadillac dealers are adding to fresh coolant is an organic cellulosic material used by car companies during production to seal any small leaks left in the engine. Cellulosic particles, which measure from .0005 to .003 in. in diameter, are sus-

pending in the coolant and pack together to form an effective seal wherever there is a leak. The material doesn't plug passages in the cooling system when recommended maintenance procedures are followed.

Cadillac puts the compound in all engines before they leave the factory. With those involved in the recall, however, not enough was used to compensate for leaks that may develop because of the reason I mentioned. The effectiveness of the additional material Cadillac now wants to put into the coolant of your HT4100 engine has been tested in temperatures from well below 0°F to above 260°F. One test, for example, involved extensive trailer towing in Death Valley. In other words, from what Cadillac has told me, there is no reason to believe that the service called for in the recall notice won't work.

In conclusion, here are two more facts I've collected: (Please turn to page 66)



Hot stuff

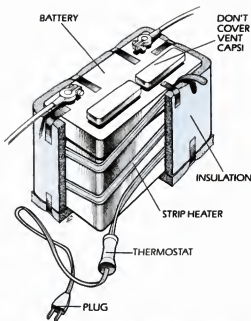
In cold weather, the battery is looked upon as the weak link in the engine-starting chain of events. But not for reader P.R. Petroff, who fashioned a heater for his battery that keeps it at 75° F when the ambient temperature is as low as 10° below zero.

P.R. wrapped a strip-heater element rated at 40 watts twice around the battery case. Strip-heater elements, which keep water pipes from freezing, are sold in hardware stores. They come in a variety of lengths and wattage ratings.

"Be sure the heater element has a built-in thermostat that's set to turn on when the ambient temperature drops below 35° F," P.R. says.

With the heater element in place, he used electrical tape to wrap fiberglass around the four sides and base of the battery, taking care not to cover the thermostat. It has to be left exposed to outside air. Also be careful not to cover holes through which battery gas vents itself. Doing so could cause a buildup of gas inside the battery, resulting in damage to the battery or an explosion.

For the electrical hookup, P.R. connected a short outdoor extension cord to the heater element and brought it into the passenger compartment through an opening in the firewall. When the car is parked, he uses a second outdoor extension cord, plugging



one end into the cord in the passenger compartment and the other end into a house outlet.

Leaving nothing to chance, the house outlet P.R. hooks the extension cord into is equipped with a ground fault interrupter, and the long extension cord from the car to the house is equipped with a 0.5-amp cartridge fuse.

"In effect, I have a 40-watt load fused for a maximum of 60 watts," he says. "The setup gives me an engine that cranks at summertime speeds and starts immediately although the actual engine temperature is well below zero."

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CAR CLINIC

(Continued from page 64)

1. If an engine that has been serviced develops a problem because of coolant leakage and the car has exceeded 48 months or 50,000 miles, the company will review the circumstances and may stand some or all of the repair cost.

2. The Cadillac letter does not apply to 1985 model engines produced after December 1984, or to 1986 HT4100 engines, which are basically the same as previous versions. The reason is that late '85 and 1986 engines are being given the added dose of the organic cellulosic sealing compound on the production line.

A fluid situation

Would you please tell me what type of fluid to use in the C5 automatic transmission of my 1982 Thunderbird. The information that is printed on the dipstick says to use Type CJ, but the owner's manual says to use Type H.

RICK SZALKOWSKI
OLMSTED, OH

Use either. In your case, in fact, you can mix Type H and Type CJ fluids without ill effects. But this special carte blanche applies only to early 1982 models that have C5 automatic transmis-

PM CAR CARE



Gummy gas

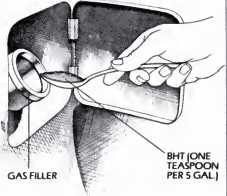
Gasoline tends to go stale in cars stored for long periods of time—nine months or longer. It turns gummy and leaves a varnish residue as it evaporates.

The best way to preserve gasoline inside a stored car's tank is, first, to be sure that the tank is filled all the way to the top. This displaces the oxygen.

Second, drop four teaspoons of powdered BHT (butyl-hydroxytoluene) in a 20-gallon tank. BHT is a common food preservative. Government tests have shown it's

sions without lockup torque converters.

When Ford came out later in 1982 with C5 automatics having lockup torque converters, the use of Type H fluid became a "must." According to engineers at Ford, Type H fluid con-



GAS FILLER

BHT (ONE TEASPOON PER 5 GAL.)

also good for keeping gasoline fresh. BHT dissolves cleanly in gasoline and doesn't affect engine parts or performance.

BHT is available for \$6 per quarter pound from Vitamin Research Products, 2044 Old Middlefield Way, Mountain View, CA 94043; or, you can phone toll-free (800) 541-8536 in California or (800) 541-1623 in the other 49 states.

tains detergents that keep particles in suspension. If not kept in suspension, these particles may settle in the torque converter and cause the converter to malfunction, which leads to a shudder.

(Please turn to page 70)

Start your own money making business!

Make up to \$26⁰⁰ an hour—
even while learning! *Train FAST
at home!*

Get into this booming high-profit business that's
Easy to learn—Easy to do—Easy on You!

Never before have money-making opportunities been so great for qualified Locksmiths. Now lucrative regular lock and key business has multiplied a thousandfold as millions seek more protection against zooming crime. Yet there's only one Locksmith for every 17,000 people!

Start Collecting CASH PROFITS Right Away

You're in "business" ready to earn \$10 to \$26.00 an hour a few days after you begin Foley-Belsaw's shortcut training. Take advantage of today's unprecedented opportunities in locksmithing for year-round EXTRA INCOME in spare time—or fulltime in a high-profit business of your own. Hundreds we've trained have done it. So can YOU! All tools plus professional Key Machine given you with course. These plus practice materials and equipment plus simple, illustrated lessons, plus expert supervision, plus business building guidance will enable you the KEEP THE MONEY COMING IN! Ideal for retirement—good jobs, too.

SEND FOR EXCITING FACTS—No Obligation

Discover what's in Locksmithing for you—how Foley-Belsaw's Master Locksmith-approved training can give you the skill you can depend on to EARN MORE—ENJOY LIFE MORE.

BE A LOCKSMITH!

Hundreds of Foley-Belsaw trained men have succeeded in this fascinating and highly profitable field...

"Before enrolling I checked other courses and also asked for advice from several locksmiths in my area. They all said yours was tops and has the most versatile Key Machine."

"I always wanted to be in business for myself and now I am... thanks to Foley-Belsaw Institute."

David Fairbrother—Dave's Locksmith Service
Milwaukee, Wisconsin 53209



"I opened my own business, spare time, seven months after I enrolled and made a profit of \$329 for the first week."
B. A. Deberry Littleton, Colorado

"No more hard, nasty work for me. Now I have my own business and with hardly any effort I average around \$50 a day. Thanks for my new start in life."

Sam Walker Prichard, Alabama



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CAR CLINIC

(Continued from page 66)

Particles floating around in Type H fluid may make the fluid a dark color. This is normal.

If there's any chance that a C5 transmission with a lockup torque converter is accidentally filled with Type CJ fluid, it should be fully drained and a new filter installed before refilling the transmission with Type H fluid. Type H fluid is available from Ford dealers in quart cans that carry Motorcraft part No. XT-4-H.

Going straight

The grease fittings in the lower front suspension ball joints of my 1983 Plymouth Reliant can't be reached with the coupler of the grease gun I use. The reason is because of the tight space between the fittings and wheel rims. To get at the fittings to lubricate ball joints, I either have to buy a special

DO YOU HAVE A CAR PROBLEM?

Just ask Mark about it. Send your question to the Car Clinic, Popular Mechanics, 224 West 57th St., New York, NY 10019. While letters cannot be answered individually, problems that are of general interest will be discussed in the column.

adapter or remove the wheels.

The Plymouth dealer turned thumbs down on another option I thought I had—replacing those straight fittings with 45° or 90° fittings. He said I shouldn't, and I hesitate to do so until I hear from you.

You see, I have the added coverage contract which provides for my not having to pay for repair or replacement of front suspension components. Will installing offset fittings on my car nullify this contract? **GEORGE LIEBERMAN**
POUGHKEEPSIE, NY

It doesn't matter whether it does or doesn't, because you can't do it. The straight grease fittings are pressed into place. Even if you manage to pull them without ruining the ball joints, you won't be able to install 45° or 90° threaded fittings. There's another reason to stick with straight fittings. They indicate when ball joints are worn. A ball joint is worn if the grease fitting moves when you attempt to wobble it back and forth by hand.

This test should be done with the car on the ground so the weight of the car is resting on the ball joints—not up on a lift.

If you don't want to buy the special adapter for lubricating ball joints, removing wheels every so often to get at the straight grease fittings isn't a tough job. Besides, it gives you the opportunity to check your brakes. **FM**

SERVICE TIPS

- Ford suggests that if you have a stalling, no-start or intermittent no-start problem with 3.8- and 5-liter engines, make sure the electric fuel pump ground wire is tight. (Good advice for any make of vehicle with an electric pump.) If the car's a Mark VII, you'll find the ground connection on the driver side rocker, beside the driver's seat. If it's an LTD or Marquis, the connection is on the passenger side rocker, beside the passenger seat. If you have a T-Bird or Cougar, look under the passenger seat on the floor pan.
- That ringing you may hear from a 1985 or 1986 Pontiac Grand Am between 40 and 45 mph is probably being caused by the speed sensor heat shield vibrating against the transaxle case. TSB 86-6-3 tells the dealer to bend the shield away from the case about 3/8 of an inch.
- Nissan recently started installing heat shields on batteries of 300ZX models to prevent high temperatures that develop under the hood from harming the battery. You can get one from a dealer for your 1984 or 1985 car by using part No. 74780-19P00.
- If you find your 1985 Charger or Turismo power steering harder to maneuver than it should be or it takes effort to straighten the wheel after a turn, ask your dealer to look at Chrysler TSB 19-01-85. It explains how to get the lower universal joint on the steering shaft away from the tow plate.

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Professionals pick Husqvarna right down the line. For good reason. You can too.

Husqvarna saws for the weekend pro are built to run and run. They're made with the same major engine components as Husqvarna's professional saws. With electronic ignition for sure, easy starts and chain brake standard.

Designed with vibration dampening and special silencers to do the toughest work without being tough on you.

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For more information contact Husqvarna Power Products Co., 224 Thorndale Avenue, Bensenville, Illinois 60106 or see the Yellow Pages for the dealer nearest you.

Motorsports



BY STEVE POTTER

Detroit goes racing



GTP March powered by a Buick V6 turbo has over 900 hp!

In Zuffenhausen, Germany, and to the south in Maranello, Italy, two of the foremost European high-performance automakers, Porsche and Ferrari, are preparing assaults on Indianapolis in 1987. This season, there's plenty of excitement brewing on the Indy car racing scene, and much of it courtesy of two Detroit automakers, Buick and Chevrolet.

The first CART/PPG Indy Car World Series race won't be held until April 4 at Phoenix, but now is the time of year when Indy car teams are busy in their shops and at track tests, completing the technical development each team hopes will bring it success in 1986.

In two months at Phoenix, look for the competition debut of the Chevrolet-Ilmor racing engine, which began serious dyno testing last summer and ran in one of the Penske team's March 85C chassis last October.

That new turbocharged

2.6-liter V8 has been developed for Chevrolet by Ilmor Engineering in England. Designed by a pair of former Cosworth engineers, the new Chevy is a "pure" (not stock block) racing powerplant. In its general layout, it resembles the engine that has dominated Indy car racing for the past decade—the Ford-Cosworth DFX.

The Chevy, which will be used exclusively by the Penske team at first, is said to enjoy a 50-hp advantage over the 720-hp output of a Cosworth. But Cosworth has implemented a special high-rev kit that extends the red-line for its engine up to a dizzying 12,500 rpm, and cuts the Chevy's predicted power advantage in half.

Last year, cars with the production-based 3.4-liter Buick V6 Turbo dominated qualifying at Indy, but proved unreliable in the race. The Buick will be back again at Indy in May. If the engineers have been able to

find some added reliability over the past year, the Buick may well be the engine to beat at the Brickyard.

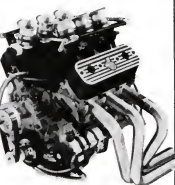
Here's why. The rules grant the Buick an 800-cc displacement advantage over the pure-bred racing engines because the rocker-arm, 2-valve cylinder head design of a conventional American production engine does not breathe as well as the double-overhead-cam, 4-valve design used on the Cosworth and new Chevy.

There's another factor in the power equation—turbo-charger boost levels. In a turbocharged engine, power is a function of how much pressure the turbo generates in the intake manifold as well as engine size, speed and valve train. In Indy car racing, boost is legislated.

Under CART rules all engines are limited to a manifold pressure equal to 48 inches of mercury. With equal boost, the Buick's displacement advantage isn't enough for it to match the horsepower of a 4-valve racing engine. But at Indy, the sanctioning body (USAC) permits the production-based Buick a 19-percent advantage in turbocharger boost over the Chevy-Ilmor and Ford-Cosworth.

That boost advantage for the Buick was translated into perhaps an additional 100 hp for 1985 pole-sitter Pancho Carter when he made his qualifying run. This year, March Engineering will run a factory car at Indy, one of half a dozen Buick-powered entries.

While Indy is the only track on the PPG circuit where the Buick looks like a winner, Buick is a partner in



Fuel-injected Buick V6 will power American Racing Series.

a new racing series designed to provide a training ground for future Indy stars. It's called the American Racing Series, and it is designed to provide a bridge between the 180-hp Volkswagen-powered Super Vees and the 750-hp Indy cars.

To keep costs down, the series uses cars of identical specification—a modified March F3000 chassis, dubbed a Wildcat—fitted with a normally aspirated, 400-hp Buick V6.

Buick will also continue its involvement with Phil Conte's IMSA Camel GT team. An intercooled, gasoline version of the turbocharged V6 makes Conte's March GTP cars the most powerful machines in sports car racing. Because IMSA has no boost limitations, the Buick produces better than 800 hp at race boost and in qualifying trim pumps out a staggering 940 hp!

PM



The March Formula 3000 chassis with a 400-hp Buick V6 will provide a large step up to the 750-hp Indy cars.

The forecast calls for



Thunderbird.

On the road, an impending storm presents a special challenge—one the driver of a Thunderbird is well-prepared to accept.

Thunderbird's electronically fuel-injected engine provides the power. Steel-belted radial tires and rack and pinion steering provide the grip. And for further stability and road control, Thunderbird's shape helps reduce front and rear lift.

Inside, you'll find the appointments of a true driver's car. Thunderbird's airflow management reduces wind noise and helps keep the windows clean. Seating areas provide lateral support for cornering. And to minimize the time your eyes are off the road, the instrument cluster provides vital information at a glance.

Of course, Thunderbird does have its limits; it can't predict the weather. It can, however, make dealing with a storm a little easier. You can drive a Thunderbird at your nearby Ford Dealer. Have a nice day.

3-Year Unlimited Mileage Warranty.

The new 3-year unlimited mileage warranty covers major powertrain components on 1986 Ford cars. Warranty is limited and certain deductibles apply. Ask to see the 3-year unlimited mileage warranty when you see your Ford Dealer.

Best-built American cars.

"Quality is Job 1." A 1985 survey established that Ford makes the best-built American cars. This is based on an average of problems reported by owners in a six-month period on 1981-1984 models designed and built in the U.S.

Have you driven a Ford... lately?



Buckle up — Together we can save lives.



CORVETTE ROADSTER

The first drop-top Vette in a decade will set the pace at the Indy 500.

BY MICHAEL LAMM
Contributing Editor

The most fun convertible I've ever driven is the 1986 Corvette roadster. (Chevrolet calls it a roadster, but it does have roll-up windows, so strictly speaking, it's a convertible.) The fun part has to do with the feelings you get in any convertible: the openness, the freedom, the sunshine and communion with nature. But more than that, in this soft top there's a remarkable extra measure of handling, performance, roadability and cooperativeness, plus personality and style.

Most cars sacrifice a lot in terms of handling when they go topless. That's because the roof of a coupe adds considerable structural strength. My own per-



Top mechanism is just like that on old Vettes—entire top disappears under the deck lid.

sonal car, a like-new 1967 Camaro RS convertible—a car I love dearly—has a noticeable amount of front-end shake and sometimes tends to porpoise down the road. That's partly because it's engineered for a very soft, compliant ride, but also because the early Camaro's body structure simply isn't all that stiff.

This new Corvette roadster, though, uses a modified version of the Vette coupe's very rigid uniframe. It compensates for the loss of the roof structure by adding reinforcement and gusseting in eight strategic places, including a



Chevy calls it a roadster, but the roll-up windows technically make it a convertible.

hefty X-member under the passenger compartment.

The roadster also rides on the Z-51's 9.5-in. alloy wheels, but its spring rates and shock valving put its ride and handling somewhere between the coupe's Z-51 package and the base car: firm but pleasant on all but very rough road surfaces, yet virtually without roll and superbly stable in high-speed cornering.

The Z-51 handling package isn't available for the roadster, but it really doesn't need it. The roadster handles superbly as is—much better than any

(Please turn to page 132)



Break away to refreshing taste.



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**SURGEON GENERAL'S WARNING: Quitting Smoking
Now Greatly Reduces Serious Risks to Your Health.**

Milds Kings, 10 mg. "tar", 0.7 mg. nicotine;
Filter Kings, 16 mg. "tar", 1.0 mg. nicotine
av. per cigarette, FTC Report Feb. '85.

THE KLM SYSTEM COMPLETE.....



The Star Performer

KLM's SBR-6100 is a totally new concept in satellite integration. With its full function remote control the SBR-6100 combines total-recall memory, a synthesized stereo tuner, and a computerized dish positioner all into one sleek unit.

Total-recall memory automatically selects the dish position, stereo selection, skew, and polarity for any channel on any satellite, all at the touch of a button.

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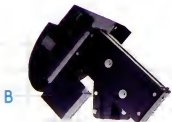
FOR MAXIMUM PERFORMANCE

The Supporting Cast



A

C



B

D



A All KLM systems come standard equipped with the time-tested black radar mesh antennas. You have a choice of 6, 8, and 11-foot sizes. The 8 and 11-foot antennas utilize an aircraft-quality perimeter cable to secure the critical parabolic shape.

B The H2H is a true horizon-to-horizon mount. With this mount, your system has a full 180° of rotation. The mount is fully factory-assembled, and its design is impervious to icing, having been tested repeatedly at -50° F.

C In one container, everything you'll need from mount and antenna, feed horn and amplifying assembly, weather-sealed cable and tuner/positioner control station. You will note from the illustration that all major components are factory pre-assembled.

A Low Cost, High-Quality Option

D The KLM Sky Eye X is available in either single or Block Downconversion. Every aspect of satellite and channel selection is at your fingertips. The lighted dial and clearly designated control knobs make tuning easy and positive.

The Aimer II is semi-programmable, low-profile, and completely self-contained with a built-in power supply. Exclusive fast pass allows you to input any satellite location in less than 12 seconds.



Electronics Inc.



It's Unanimous

(Even the competition says ESCORT's the one to beat)

It's easy to see who sets the pace in radar warning. Just read all the detector ads. Most of them claim to be as good as ESCORT. A few say they're better.

At least they agree on one thing. ESCORT is the one they have to measure up to.

A modern classic

ESCORT was a radical piece of electronic engineering in 1978 when it was introduced, the first practical use of superheterodyne technology to warn of police radar. *Car and Driver* magazine said, "...the radar detector concept has finally lived up to its promise."

Since then, our engineers have never stopped refining that technology. ESCORT may look the same on the outside, but it never stops getting better on the inside.

Standard of comparison

Now, when experts refer to the high-water mark in radar protection, they automatically turn to ESCORT. In March of this year, *Car and Driver* published its latest detector test, this one comparing remote-mounted models. ESCORT is designed for dashtop or visor mounting. But the magazine included ESCORT in the test anyway, as the reference against which the performance of the others would be measured. ESCORT scored 412 points in the final rating, compared to 274 for the highest-finishing remote. You might say the comparison showed that there is no comparison.

A gilt-edged reputation

Seven years is a long time in the radar warning business, but there is no shortcut to a good reputation. *Car and Driver* said, "The ESCORT radar detector is clearly the leader in the field in value, customer service, and performance..."



These excerpts were taken entirely from advertisements for other radar detectors.

So it's easy to understand why other detectors would try to stand in our limelight. ESCORT has seven years worth of credibility, the one quality that money can't buy in this business.

Check our references

Credibility doesn't come from extravagant claims. It comes from satisfying customers. You probably know someone who owns an ESCORT (nearly a million have been sold). So ask about us.

ESCORT pioneered superheterodyne receiving circuitry. Ask if our radar warnings always come in time.

ESCORT's reporting system combines an alert lamp, a variable-rate beeper that distinguishes between X and K band, and an analog meter, all to give an instant indication of radar strength. Ask if our warning takes the panic out of radar.

ESCORT is sold in one place only, the factory that makes it. This lets you deal directly with experts. Any of our staff of over 60 sales people will be glad to answer any questions you may have, about ESCORT or about radar in general.

We've been solving people's radar problems since 1978. How can we help you?

Try ESCORT at no risk

Take the first 30 days with ESCORT as a test. If you're not completely satisfied return it for a full refund. You can't lose.

ESCORT is also backed with a one year warranty on both parts and labor.

ESCORT \$245 (OH res. add \$13.48 tax)
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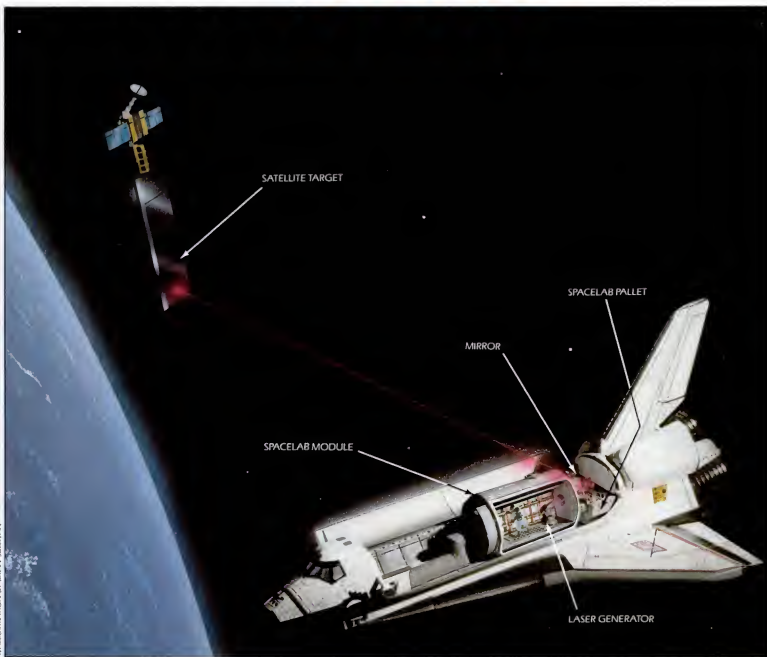
By mail send to address below. Credit cards, money orders, bank checks, certified checks, wire transfers processed immediately. Personal or company checks require 18 days.

ESCORT

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Cincinnati, Ohio 45296-0100

PM TECHNOLOGY UPDATE 2/86



PM ILLUSTRATION BY BRIAN SULLIVAN

'Star Wars' laser to undergo test

Laser beam tracking and firing will be tested on board the Space Shuttle sometime this year by the Strategic Defense Initiative (SDI) space-based missile defense program.

SDI has reserved the Shuttle and the European-built Spacelab module to demonstrate tracking and

pointing capabilities necessary for future U.S. satellites to destroy Soviet ballistic missiles in flight. During the mission, laser beams fired through a window in the Spacelab module will strike one or more large mirrors mounted on a Spacelab pallet, then be reflected toward satellites or other targets.

Targets that are under consideration include the German ERNO SPAS Shuttle pallet satellite released during mission seven or the Goddard Space Flight Center Spartan satellite used last June. Researchers are also considering aiming the beam earthward where ground-based sensors could deter-

mine the potential for actual battle lasers which would engage Soviet missiles shortly after lift-off, while the warheads are still in the lower reaches of the atmosphere.

Editor: Dennis Eskow
Assistant Editor: Ted Francis
Contributors: Michael Fillon, Marjorie Carmela, Chris Mitchell, Ken Sanders, Jack Hammond

TECHNOLOGY UPDATE 2/86

RECREATION

Sea Journey

Epco Center's "Living Seas" exhibit offers visitors a scientific as well as entertaining journey through a replica of a Caribbean coral reef. The main tank is 200 feet in diameter and 27 feet deep and features 2000 tropical fish, dolphins and sharks. Visitors will view live presentations recorded by a camera aboard a submersible and visit Seabase Alpha, an undersea research center.



PM ILLUSTRATION BY ED VALCOURY

ROBOTICS

A firefighter with mettle

Ro-Veh usually disarms bombs, but here (below) it's outfitted with a thermal image camera and hose connections for fighting fires. Ro-Veh can climb stairs and can pick out a human form in a smoke-filled room with its infrared sensors.

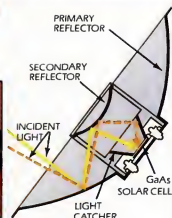


SOLAR POWER

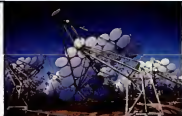
New space solar cell



The gallium arsenide solar cell (above) in a special reflector will produce 100 times



the power of a silicon cell. NASA is testing the gallium arsenide reflector on a future Shuttle launch.



Quick! A mirror

LaJet Co. of Texas is producing a snap-on reflective cover for solar concentrators. Mirrored surfaces degenerate due to wind and grit. They are easily replaced with a thin film of fit-all reflective mylar (above), solving a vexing of solar energy problem.

PM ILLUSTRATION BY GEORGE RETSECK



ASTRONOMY

Star dishes

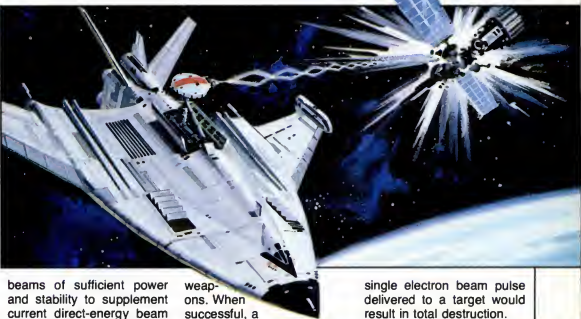
Caltech's Millimeter Interferometer is made up of three 24-foot antennas which can be moved on tracks to focus on planets, stars, interstellar

molecular clouds and galaxies. The array produces high-definition pictures of astronomical bodies. The radio telescope is viewing the Orion Nebula with hopes of recording the birth of a star.

ENGINEERING

Electron ray space tested

Besides lasers, the Strategic Defense Initiative is expected to use futuristic weapons such as a satellite-smashing electron beam (drawing at right). Sandia Labs has produced the first electron beam using RADLAC II, its induction linear accelerator, the highest powered in the United States. The program, sponsored by the Air Force Weapons Laboratory and the Defense Advanced Research Projects Agency, is aimed at producing electron



beams of sufficient power and stability to supplement current direct-energy beam

weapons. When successful, a

single electron beam pulse delivered to a target would result in total destruction.

OPTICS

Laser tracks satellites

The Royal Greenwich Observatory is using a laser light pulse (right) to monitor the Earth's rotation. The laser generator, called Satellite Laser Ranger, monitors the three passes a day of Lageos, the laser geo-dynamic satellite launched in 1976. Lageos gathers information on the Earth's rotation, geometry and surface changes. Ranger, the most accurate laser measuring device in the world, is used to demonstrate the correlation between the global wind pattern and Earth rotation speed.



Lighting the flame of Liberty

When the Statue of Liberty is relighted in July 1986, a new lighting scheme, based on a sculptor's ideal and advanced General Electric metal halide multivapor lamps (above left), will bathe the statue. Two new lamps will be used: One projects a cool white light that emphasizes

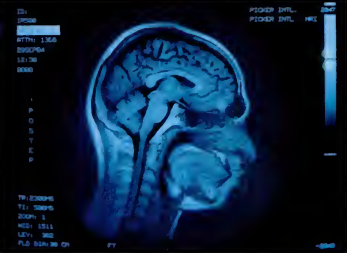
the folds of Liberty's robes and the other throws a warmer light that complements the statue's green surface patina (above right). At night, Liberty will appear to be basking in sunlight. The lamps are energy savers, costing less to run than the lamps in Liberty's original torch.

MEDICINE

Magnetic 'eye' aids diagnoses



The Nuclear Magnetic Resonance scanner (NMR) is enabling medical personnel to "see" the body's soft tissues, ordinarily invisible to X-rays, ultrasound and C.T. scanners. The NMR produces detailed images on a monitor (right). A patient (left) is wheeled inside the NMR's superconducting cryogenic magnetic bore (10,000 times stronger than the Earth's magnetic field). The magnet excites the body's hydrogen atoms and translates the reading into a visual image.



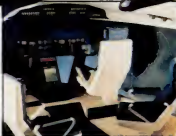
TECHNOLOGY UPDATE

AVIATION



More than a bag of wind

Advanced technology is going into Goodyear's GZ-22 airship (above). The first airship with 420-hp turbine engines and ducted fan props allowing it to move straight up and down, it will also feature a new car (above right) 10-feet longer than current cars. The car will hold nine



passengers instead of the current six. GZ-22 will fly 15 mph faster than the discontinued GZ-20 operating for the last 25 years.

Testing, testing

Lockheed's High Technology Test Bed aircraft (below) has set three short takeoff and landing "time-to-climb" records. The C-130 is used to validate aerospace systems concepts using advanced displays and telemetry.



Happy birthday, big boy!

The first of 50 mammoth C-5Bs (above) bought by the Air Force is set for delivery. The updated version of the C-5A incorporates an improved wing, improved G.E. engines, tougher aluminum alloys and state-of-the-art avionics. The C-5B is capable of transporting two M-1 battle tanks, operating from unpaved airfields and unloading and loading outsized cargo from each end.

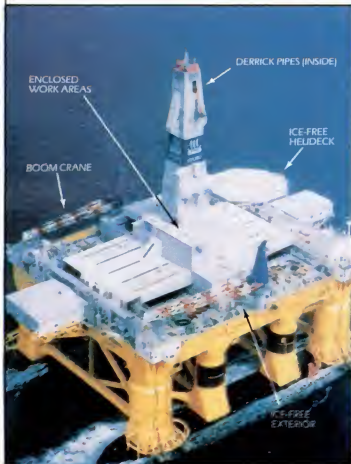
PHOTO BY TALAT MUHAMMAD

MARINE

Oil rig melts exterior ice

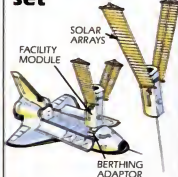
The first semisubmersible Arctic oil rig (below) is headed for duty off Norway. Heated, enclosed work areas provide crewmen with a shirt-sleeve working environment despite below-zero

temperatures and 125-mph winds. The helideck and underside are also heated to thwart rig-sinking ice buildup. To move the rig, pontoons are filled with air and the rig is towed from drilling site.



AEROSPACE

Space factory set



NASA has commissioned Space Industries Inc. to build and deploy an Industrial Space Platform (above). The platform will measure 35 by 14.5 feet. The ISP, scheduled for deployment by the Shuttle in 1989, will conduct experiments in pharmaceuticals,



crystal creation, alloys and biochemistry.

PHOTO BY GEORGE RETZKE

Cockpit array for Hermes set



The cockpit for the French Hermes manned shuttle craft is based on Aerospatiale's 2-crew integrated flight station developed for Airbus Industrie's transport aircraft. The Hermes panel incorporates five wide-screen cathode ray tube flight instruments.



MILITARY

These moving targets do much more



A vehicle for all reasons

The French Army's Ultrav-M11 ultralight, armored, 4-wheel-drive vehicle (above) is designed to operate day or night in nuclear or chemical environments. The Ultrav can be rigged for amphibious propeller propulsion within two minutes. It can be carried by airplane or helicopter and is air-droppable. Along with the Milan antitank system, the Ultrav could be put into action to stage behind-lines tank ambushes.

Boeing-Goodyear and Martin-Marietta-Caterpillar Tractor recently unveiled their versions of Hard Mobile Launchers: nuclear-blast-hardened vehicles designed to keep small ICBMs on the move and out of enemy sights. The Boeing-Good-

rich vehicle (above) is 92 feet long, 12 feet wide and 6



feet high and is equipped with two diesel engines driving 14 all-terrain wheels at a top speed of 60 mph. The Martin-Caterpillar vehicle (left) is 85 feet long, 12 feet wide and 8.5 feet in height. The Air Force is expected to develop one of the designs.

Field soldiers' tank killer

The Milan antitank system (right) may be the field soldier's best defense against the tank. The infrared guided missile replaces the 1000-yard Dragon, which lacked the penetration to disable the newer Soviet tanks. The operator aims at the target and presses the firing button. He sees a luminous moving spot in his sight that reproduces the missile's trajectory. Once

the missile is launched, the operator maintains the sight aimed at the target until impact. The Milan antitank missile is automatically slaved to the line of sight.



Drone hauls tows



Northrop's Chukar II aerial target vehicle (above) rockets from a British vessel carrying two tow-bodies on its wingtips. Tows contain miss-distance measuring devices and target simulators and are deployed 600 feet behind the drone to reduce the chance of damage.



Coffee, tea or refueling

Boeing Vertol has achieved the first in-flight refueling of a U.S. Army Chinook helicopter. The test employed a CH-

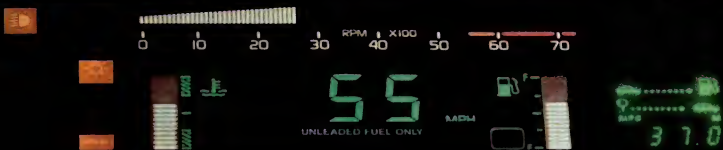
47D and an Air Force HC-130 tanker (below). The CH-47D approached the HC-130 from behind and inserted

a 38-foot retractable composite fuel probe into a 48-inch-diameter drogue attached to the HC-130's 76-foot line. Fuel was transferred through the HC-130's fuel line into the fuel probe located along the CH-47D's side. The refueling took place at 5000 feet at 120 knots. At 150 gallons a minute, it took 6 minutes.



The Promise.

Renault's European technology brings high style to Encore's engineering.



The Proof. Encore Electronic

The 1986 Encore is easy to look at, especially when seen through Renault's LCD (liquid crystal display) instrumentation. It's a bright, clear display that tells you things you never knew about your Encore. The electronic instrument cluster features LCD readouts for speedometer, a graph bar tachometer, fuel level gauge, and a trip computer displaying remaining fuel, distance to empty, average fuel consumption, outside temperature, distance traveled and average speed. There's even more to see in the 1986 Encore: New standard features such as a restyled front end, brighter halogen headlamps and improved electronic fuel injection for better fuel economy. 41 MPG HWY, 35 MPG CITY.* New options include Accusound by Jensen, a premium 6-speaker system, and tilt steering wheel. Renault Encore's European technology, **Built in America** with 5/50 Plus, America's best small car protection.** Visit your Renault dealer; test the proof behind our promises in the 1986

Encore Electronic. *Use EPA est. for comparison. Your results may differ. (Based on 1.4-litre engine, w/4-spd. man. trans.) **5 yrs. or 50,000 miles. Limited warranties. Certain restrictions apply. See your dealer for details.

Buy or lease. From American Motors. ■ Safety Belts Save Lives.

RENAULT

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Washington nor Pearl Harbor anti-

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75 Years Of Naval Aviation

From the vast oceans of Earth to the deep darkness of space, Navy aviation has reshaped the world since its start in 1911.

BY DENNIS ESKOW, Science/Technology Editor

We had shown the world we could dominate the high seas. And we had proven to ourselves that we could take to the skies. But on that cool winter morning of Jan. 8, 1911, America was on the threshold of opening an entirely new frontier in national defense. A few seconds after 11 a.m., about an hour after the early morning fog burned off, Eu-

Photo montage depicts Lt. Theodore G. Elyson, the first naval aviator. Elyson flew the biplane making a take-off, shown in the center of the montage. Above, with its tail facing us, is the first Navy blimp. Above it is the *Shenandoah*, the first naval rigid airship. Navy pilot Bruce McCandless is shown flying NASA's rocket chair. The battle (bottom) is Pearl Harbor at the start of World War II.

gene Ely flew a Curtiss Pusher over San Francisco Bay. From about 500 feet he spotted the deck of the armored cruiser USS *Pennsylvania* as she bobbed in the water. The ship sported an odd-looking platform at her stern, a slightly upward sloping "boardwalk" of wood planks elevated on posts atop the deck. Ely gently pushed down the nose of the airplane and brought her down on



the deck. He was greeted by exuberant officers and crew, and after a debriefing, he climbed back into the pusher

and took off at 11:58 a.m. for Selfridge Field, San Francisco. This stopover was the earliest demonstration of the potential for aircraft carrier operations. It was the dawn of naval aviation.

The official start of naval aviation is recorded as May 8, 1911, when the first officer in charge of aviation—one Capt.

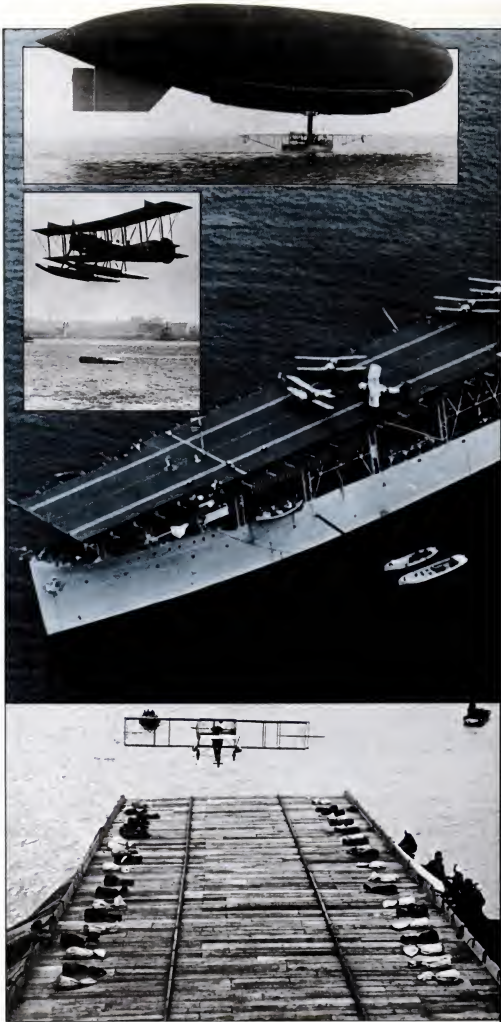
Washington I. Chambers—put in requisitions for two Curtiss biplanes. But the Navy has reserved all of 1986 to celebrate the diamond jubilee of Navy flying. Actually, the age of the Navy's air operation could even be greater than 75 years.

As early as 1898, when Teddy Roosevelt was assistant secretary of the Navy, a board was appointed to investigate the claims of one Samuel P. Langley. Prof. Langley's invention was called The Aerodrome. It was a powered flying machine that could allegedly be shot into the air by a set of springs mounted on a track. Two trial launches were made from atop a houseboat in 1903. The plane went into the Potomac River both times. Roosevelt was a stubborn believer and he continued pushing the

idea of short takeoffs for aircraft—as from a ship's deck, for instance. He made little progress during his own administration, but his hand-picked successor,

William Howard Taft, was sitting in the White House the day Ely made the first "carrier" takeoff and landing.

Ely was a civilian, but the Navy, even before ordering its first plane, began training Lt. T.G. Elyson as a pilot in December 1910. Over the next decade, the growing ranks of Navy aviators would pilot the first flying boats, make the first successful catapult takeoff from a ship's deck—confirming Langley's theories—and fly the service's first nonrig-



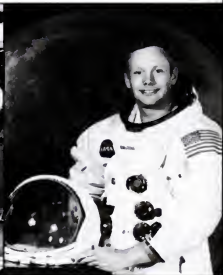


First airships were used in coastal patrol work (far left). One of the earliest torpedo bombing tests was in Guantanamo harbor (far left, below). The *Langley* (left) was America's first carrier. Eugene Ely lands on the *Pennsylvania* in 1911 (bottom left). PBVs (above) guarded coasts while F6Fs (below) formed first Blue Angels squadron. R.G. Smith painting depicts Battle of Midway.





Barshee jets (top) were among first Navy combat jets. The advanced F-18 (center, above) is shown flanked by an Iroquois river patrol helicopter (left) and a fleet of Stallion freight-hauling helicopters. The choppers were Vietnam vets. The F-18 is the newest plane in the fleet. Navy aviation has strutted its stuff in the space program. John Glenn, a Marine, was the first American in orbit. He's shown entering space capsule (right). Neil Armstrong (far right), first man on the moon, was a naval aviator. Squadron insignias throughout the story represent units whose emblems depict a variety of action, from attack to rescue.



id airship. Unromantically dubbed the DN-1, the airship could hardly get airborne in its early tests. But by 1923 our Navy crews were flying the first rigid airship in the U.S. Fleet, the *Schmeidler*, a pioneering vessel in the use of helium instead of hydrogen. Airships would go on to be-



come the major look-outs for defensive fleets, and they were even used experimentally to launch and catch in midair I-man military planes.

While the handling of flying machines at sea was becoming a pure science, naval experimenters were pushing their new machines for all sorts of



capabilities. In February 1913, Lt. J.H. Towers reported that planes practicing at the Guantanamo Bay base in Cuba had engaged in successful target bombing runs from 1000 feet. His unit also took the first aerial photographs of a fleet and used the first radios in cockpits.





Experimental naval aircraft include the Harpoon Missile-equipped Orion (above) and the Bell Textron tilt-rotor plane (left). The aircraft carrier Nimitz is shown at sea below, with a squadron of fighter planes passing over.



It all came together in July 1919 when the coal-carrying ship *Jupiter* was transformed to the nation's first aircraft carrier and recommissioned the USS *Langley*. Until the commissioning of the *Langley*, Navy aviation lived out of a suitcase, flying from land bases and jury-rigged ships.



During the First World War, naval aircraft were used mostly to follow ship convoys and bomb enemy subs.

Toward the end of the war the Navy took delivery of its first Navy-Curtiss (NC) aircraft, forerunners of long-range fighter-bombers. In 1919 three NCs took off from Rocka-



way Beach, New York, on the first trans-Atlantic flight. Two planes landed at sea and were picked up. A third landed in the Azores.

The post-war years saw rapid expansion of naval aviation, which proved to be America's saving grace in World



(Please turn to page 153)

GRAND LUXE



Sleek new bodywork, enhanced performance and advanced technology are making imports more desirable, and expensive.

BY RICH TAYLOR, Contributing Editor

The era when "import" and "economy car" were synonymous is long gone. Sure, you can still find a few low-priced imports, and

more are on the way (see *Invasion Of The Microcars*, page 95). But for the most part, imports have moved upmarket, offering more luxury, more performance,

more sophisticated gadgetry and more prestige, all for more money, of course.

Carmakers are still competing fiercely, but for the most part they're competing with new and exciting hardware, not lower prices. For people who like cars (and can afford them), the late-'80s will mark a golden era in imported car design.

Here's how the importers' offerings stack up for 1986, arranged in order from the largest automobile importer, Toyota, to the smallest, Pantera.

Toyota

Toyota sells half a million cars in the U.S. each year, more than any other import car company. All its models enjoy minor changes for 1986, but only the Celica and Supra



TOYOTA CELICA



HONDA ACCORD

FOR BIG BUCKS



MAZDA 323



PANTERA GT5

IMPORTED
86
CARS

are radically different.

The big news is the all-new Celica. The Celica is now front-wheel drive, with a 2-liter, 4-cylinder engine rated at up to 135 hp in the 16-valve GT-S version. The Celica is still a 2+2, but the styling is now very aerodynamic, with flush glass and rounded corners. The notchback looks something like Subaru's XT, the fastback something like the Mitsubishi Cordia. Both will no doubt be tremendous hits, especially with a base price of just \$9000.

Toyota's big sports machine, the Supra, is equally new. The twin-cam inline Six has been enlarged to 3 liters, the chassis has been redone—though it remains rear-drive—and the body has been restyled to look remarkably like Mazda's new RX-7. Both sets of designers were obviously daydreaming about Porsche's 944, but Mazda got the RX-7 to market first. It will be interesting to see which 944 clone is more popular.

Honda

After revamping almost their whole line in 1985, Honda's engineers have been relatively quiet for '86. . . at least by Honda standards. The trend-setting Accords have been redone. The body is all-new and more aerodynamic, though very similar in appearance to the 1985 model. Power is by a fuel-injected 2-liter Four.

The Prelude shares the new fuel-injected engine and becomes a rocket ship in 110-hp Si trim. Body color bumpers and rear spoiler give it an appearance very similar to BMW's pricey 635CSI. The Civic receives only minor improvements, though the marvelous CRX Si fuel-injected engine is now available in the Civic Si hatchback. Nobody needs more car: it's cute, fast, comfortable, durable and inexpensive.

Acura

This spring, Honda is introducing not only a new car, but a new company. Acura is the nameplate, and there will be two models. The Integra is based on the Honda Accord, but with a 1.6-liter, double-overhead cam 4-cylinder engine. There will be 3-door and 5-door hatchbacks, priced between \$10,000 and \$15,000.

And the second Acura model is the pricey Legend. This will also come as a coupe or sedan, powered by a 24-valve V6. Standard engine will be a 2-liter; optional will be a 2.5-liter. Prices for the Legend will range from around

\$13,000 to \$20,000. Starting in 1987, Florida entrepreneur Norman Braman will import essentially the same car with European amenities (wood trim) from Britain. Code-named the Rover XX, the car will be built by the Austin Rover Group in a joint venture with Honda.

Nissan

The whole Nissan line receives minor restyling for '86. The BMW-looking Stanza and Sentra economy sedans will be here this spring and be called 1986½



Mazda's extensively revised RX-7 sports car has Porsche-inspired styling and performance. Wankel engines produce 146 to 180 hp.

models. The boxy Stanza wagon is now available with 4-wheel drive, and next fall Nissan will unveil the Mid-4, a powerful V6 mid-engine, four-wheel-drive 2-seater, similar to Toyota's

The Alfa Romeo Milano is a 4-door sedan version of the gutsy V6-powered GTV coupe, priced at \$13,500.



lustworthy MR2. If nothing else, the Mid-4 ought to make a wonderful mount for Pro Rally racers to banzai through the woods.

Mazda

The RX-7—already considered a modern classic—has been completely redone (see *Firsthand Drive Report*, page 48, Nov. '85). The only thing left over from the previous RX-7 is the 13B Wankel rotary engine, now rated at 146 hp. A new, sure-handling, all-independent suspension, vented 4-wheel disc brakes and a host of clever details make the \$12,000 2-seater a delight.

The RX-7's styling is a bland mix of Porsche 944 and Chevrolet Camaro, with just a dash of Dodge Daytona Z. This spring there will be a 180-hp turbocharged version that will mix Porsche-like performance with a \$19,000 price tag. The 140-mph RX-7 Turbo will be both the strongest and most expensive car that Mazda has ever offered.

The GLC is now called by its Japanese designation, 323, and is completely new for 1986. It's more aerodynamic, faster and more comfortable than last year's car. In the spring, the 323 will receive an optional turbocharged engine to turn it into a Pocket Rocket.

The best selling 626 has a more aerodynamic nose fitted with European-style flush headlights. There's also a new 120-hp turbocharged 2-liter engine

that finally gives the 626 some long-overdue oomph.

Next fall, Mazda will bring in its first-ever luxury sedan, the 929. This \$20,000 rotary-powered 4-door will compete against sports sedans like the Toyota Cressida, BMW 325e and Saab 9000. Judging from Mazda's success in every other market segment, the 929 ought to be a popular and desirable car.

Subaru

After introducing all-new models in each of the past two years, Subaru is taking some time off. A new 3-door



VW spruces up its Vanagon line with bigger engines, rectangular headlights and 4wd.



Saab 9000 is a big 5-door luxury hatch with Saab's powerful 16-valve Intercooled turbo Four, mounted transversely for the first time. You have to drive it to believe the performance.

hatchback will appear this spring, with optional 4-wheel drive, but that's the only big news. Like all Subaru models, it will have electronic fuel injection.

Minor tweaks include adjustable air suspension on 4x4 station wagons, standard-equipment power accessories on the limited-production RX sedan and no back seats in the BRAT. This means the BRAT is now officially a truck, exempt from import restraints but subject to a stiff 25 percent tariff.

Volkswagen

The tried-and-true Scirocco will be given a shot of horsepower come spring by way of a 16-valve head; the same engine will go in the Golf GTI in 1987. The Quantum, VW's version of the Audi 4000, will be available with 4-wheel drive starting in the spring.

The time-honored Vanagon has also been fitted with 4-wheel drive to create

WHAT'S IT COST? SUGGESTED RETAIL BASE PRICES FOR EVERY 1986 IMPORTED CAR

ECONOMY CARS

Yugo GV	\$3990
Subaru Hatchback	\$4989
Chevrolet Sprint	\$5380
Dodge/Plymouth Colt	\$5431
Toyota Tercel	\$5448
Mitsubishi Mirage	\$5459
Honda Civic	\$5479
Mazda 323	\$5495
Nissan Sentra	\$5499
Chevrolet Spectrum	\$6948
Volkswagen Golf	\$6990
Isuzu I-Mark	\$7149

SPORTS CARS/SPORTS SEDANS

Honda Civic CRX	\$6729
Nissan Pulsar	\$8349
Subaru XT	\$8371
Mitsubishi Cordia	\$8689
Toyota Celica	\$9098
Nissan 200SX	\$9199
Volkswagen Scirocco	\$9980
Honda Prelude	\$10,549
Isuzu Impulse	\$10,949
Toyota MR2	\$11,289
Mazda RX-7	\$11,995
Dodge/Plymouth Conquest	\$13,417

Alfa Romeo Milano	\$13,500
Alfa Romeo Graduate	\$13,999
Mitsubishi Stanion	\$14,829
Audi Coupe GT	\$15,555
Alfa Romeo GTV6 2.5	\$16,500
Merkur XR4Ti	\$16,503
Toyota Supra	\$16,558
Nissan 300ZX	\$16,799
BMW 325	\$19,560
Porsche 944	\$22,950
Maserati Biturbo	\$26,874
TVR 280i	\$28,300
Porsche 911 Carrera	\$31,950
Jaguar XJ-S	\$36,000
BMW 635CSi	\$41,965
Bitter SC	\$45,700

Mercedes-Benz 560SL	\$48,200
Porsche 928S	\$50,000
Lotus Esprit Turbo	\$52,000
Lamborghini Jalpa	\$53,500
Ferrari 328 GTB	\$54,300
DeTomaso Pantera	\$55,000
GTS	\$55,000
Ferrari Mondial	\$59,500
Ferrari Testarossa	\$87,000
Aston Martin V-8	\$110,000
Lamborghini Countach	\$110,000

SEDANS

Toyota Corolla	\$7148
Mitsubishi Tredia	\$7199
Subaru Sedan	\$7391
Chevrolet Nova	\$7435
Volkswagen Jetta	\$7950
Honda Accord	\$8429
Dodge/Plymouth Colt	\$8814
Vista	\$8895
Mazda 626	\$8937
Toyota Camry	\$9378
Nissan Stanza	\$9649
Renault Sportwagon	\$9995
Saab 900	\$12,285
Peugeot 505	\$12,615
Mitsubishi Galant	\$12,699
Volkswagen Quantum	\$13,595
Nissan Maxima	\$13,699
Audi 4000S	\$14,230
Volvo DL	\$14,370
Saab 900 Turbo	\$18,695
Peugeot 505 Turbo	\$18,740

LUXURY SEDANS

Toyota Cressida	\$16,130
Audi 5000S	\$18,065
Volvo 740	\$18,240
Saab 9000 Turbo	\$21,945

Volvo 760 GLE	\$22,960
Mercedes-Benz 190E	\$23,700
BMW 524td	\$25,560
Jaguar XJ6	\$32,250
Mercedes-Benz 300E	\$33,900
Mercedes-Benz 190E 2.3-16	\$34,800
BMW 735i	\$38,280
Mercedes-Benz 420SEL	\$45,100
Mercedes-Benz 560SEL	\$53,300
Mercedes-Benz 560SEC	\$58,700
Maserati Quattroporte	\$66,710
Bentley Mulsanne	\$102,920
Rolls-Royce Silver Spirit	\$103,500
Bentley Mulsanne L	\$113,860
Rolls-Royce Silver Spur	\$114,500
Rolls-Royce Camargue	\$150,600
Bentley Continental	\$163,245
Rolls-Royce Corniche	\$163,800
Aston Martin Lagonda	\$167,000
Rolls-Royce Silver Spur Limousine	\$198,000

All prices are manufacturer's suggested base prices at press time and subject to change. See your dealer.

the Syncro, while the Golf will get optional 4-wheel drive in another year. At that point, VW/Audi will be the first European company and second carmaker anywhere—after Subaru—to offer 4-wheel drive on every model.

Volvo

Volvo's sports/luxury 740/760 series is basically unchanged for 1986. The traditional 240 series sedans, however, have been restyled for the first time in 20 years. The boxy look is out; the

aerodynamic look is in. The trusty Volvo rear-drive, 4-cylinder chassis remains basically the same.

In 1987, Volvo will introduce a personal/luxury coupe, reincarnation of the chop-top Bertone of the '70s. The new car will be built from the 740 Turbo chassis, and will be called the 780. The styling is surprisingly BMWish, as is the \$30,000 price. The 780 will obviously be a limited-edition "prestige" car.

Mercedes-Benz

Celebrating its 100th birthday in 1986, Mercedes has changed every car in its line—an unprecedented amount of

engineering activity for the usually staid Stuttgart carmaker. The 190 luxury/economy sedan remains externally unchanged, but under the hood you can order an all-new 2.5-liter, 5-cylinder diesel engine. The gas engine remains a 2.3-liter Four.

For well-heeled hot-rodders, Mercedes offers the 190E 2.3-16. This \$35,000, 2.3-liter sedan is fitted with a 16-valve head developed by Formula One and Indy engine-builder Cosworth. To handle the extra performance, there's a heavy-duty chassis and distinctive AMG-style air dam and

(Please turn to page 132)

Steering to the Four



Toyota FXV with 4ws is built on a full-time, 4-wheel-drive chassis.

Four-wheel steering is the latest wrinkle in import tech from Toyota, Mazda and Nissan. Can production models be far behind?

When PM arrived at the Tokyo Motor Show last November, our first stop was the Toyota exhibit to see the FXV concept car. The first thing we did was slide under it to see what we knew was really new about the car: 4-wheel steering.

Compared to the Nissan Mid-4 and the Mazda MX-03 (see last month's *Imports*, page 12), the Toyota system is unique in that it features a direct mechanical connection between the front and rear wheels for simplicity. The Nissan and Mazda systems operate using electronic sensors, which measure the vehicle's speed, attitude, and the front and rear wheel slippage to adjust the toe-in or -out of the rear wheels. Those systems tend to react well to a specific driving situation, but Toyota hopes to provide a simpler 4-wheel-steering system for production cars.

According to Dr. Teruhiko Yamamoto, Toyota's chief designer in its Product Planning Office, the system does take some getting used to. When will we see

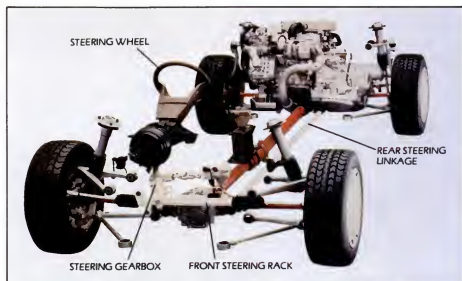
a true 4ws system on a production car? "Maybe at the next Tokyo Motor Show, in 1987," he said.

The Toyota FXV, with its 4-wheel drive and 4-wheel steering, also incorporates many hi-tech engine, suspension and electronic features—as much as the engineers could stuff into the 4-door aerocar. Its 2-liter engine has both a supercharger and turbocharger and is mounted in a mid-engine configuration.

Magnesium fiber-reinforced metal (FRM) pistons, a distributorless ignition system, a resin intake manifold as well as a ceramic turbine wheel (also found on the 1986 2-liter Nissan Z-car in the Japanese market) contribute to the powerplant's light weight and efficiency.

Inside the car is a CRT display similar to one on new Buick Rivieras. The FXV screen broadcasts in full color and the driver can control the suspension setup, air conditioning, Compact Disc player or 8-mm video display via the system, or even dial the in-dash cellular telephone through the touch-screen. Road speed is projected on the windshield in jet-fighter "heads-up" style. A 5-speed electronically controlled automatic transmission (possibly to be used on the 1987 Cressida model) gets the power to the full-time 4wd.

An electronically controlled antiskid system, modeled after Bosch's, is on the FXV, and may show up in 1987 on Supra models.—S. Parker



In the Toyota FXV 4-wheel-steering system, there is a direct mechanical linkage from the steering gearbox to front and rear wheels, unlike Mazda's and Nissan's electronic setups.

IMPORTED
'86
CARS



German Opel, built in Korea, will be sold by Pontiac.

INVASION OF THE MICROCARS

Get ready for a wave of low-priced imports from faraway places.

BY MICHAEL LAMM, Contributing Editor

You'll be hearing a lot of funny-sounding new car names pretty soon—names like Daewoo, Kia, Suzuki, Skoda, Datsun, Hyundai, SEAT and Yugo. Cars with all those names are on their way to the U.S. now. Some will set up shop in 1986, others plan to introduce their wares in 1987 and '88.

They'll bring new meaning to the term *low bucks* and a lot more competi-

tion to the \$4000 to \$6000 end of the market. Most are what we call micro-cars—hatchbacks with 1.0- to 1.6-liter engines. Most of them have front-wheel drive, and many are clones of existing cars from other countries.

And if these imports catch on here, their odd-sounding names might well become household words. Like Volkswagen. They'll also receive mixed reactions from Motor City. Not that Detroit

is totally unprepared, because in the cases of Daewoo and Kia, Pontiac and Ford have already sent out invitations. Here's what's happening:

Pontiac wooed Daewoo

General Motors currently owns 50 percent of the Korean automaker Daewoo, and Daewoo is preparing to produce a "world car." This 40-mpg, 1.5- to 1.6-liter front-wheel-drive se-



The \$3990 Yugo GV (top) leads low-price parade, for now. It's on sale in East Coast states. Suzuki Samurai (above, left) is now on sale in Georgia, Florida and California for \$6200. Daihatsu Charade (above, right) will enter U.S. in '87. Nissan plans to build its 1-liter March (right) in Taiwan and ship it to the U.S.



dan/hatchback will be based on the new and highly successful European Opel Kadett, developed by GM's German subsidiary.

Daewoo also is building a new assembly plant outside Seoul to produce just this car, which should go on sale worldwide in 1987. The plant will give Daewoo the capacity to build up to 250,000 cars a year.

Pontiac has said that it will start importing Daewoos at an undisclosed future date, reportedly 1987. This will make Pontiac the first U.S. motor division to take on a Korean car as a captive import.

Ford fires up Kia

Ford looks forward to a similar arrangement with Korea's No. 3 vehicle manufacturer, Kia Industries. Since 1980, Kia has been building only vans and trucks, but starting in 1987, Kia Industries will produce a car called the

Festiva. When that happens, Ford plans to put some into its U.S. showrooms.

Kia used to make a variant of the Mazda GLC and will again turn to a Mazda design, probably the latest 323 with both 1.0- and 1.5-liter engines. The Ford/Mazda/Kia deal calls for Mazda to at first supply Kia with engines, transaxles and technical expertise. After production shifts into high gear, Kia will make and assemble all its own components.

Ford owns 25 percent of Mazda, and Mazda owns 8 percent of Kia, so the relationship seems a natural.

Small Samurai

Visitors to Hawaii and Puerto Rico have been renting these Japanese mini-Jeeps for years. Tourists have wondered why they haven't been available on the mainland. Actually, similar vehicles from Suzuki were offered in some

states (see *Letters* on page 7), but they didn't catch on.

U.S. Suzuki Motor Corp. will try again in 1986, this time with the 4 x 4 Model SJ413, also called the Samurai. The 1986 U.S. Samurai made its debut in California, Florida and Georgia last November, offered in open and hardtop forms. It uses a 1.3-liter, 4-cylinder ohc engine, a 5-speed transmission, and a 2-speed transfer case. The Samurai spans a 79.9-in. wheelbase, is all of 135 in. long, weighs 1900 pounds and has a \$6200 base price.

Suzuki also produces the Cultus sedan, which General Motors sells here as the Chevrolet Sprint. (GM also distributes the Cultus in Canada as the Pontiac Firefly.) But the Cultus probably won't be imported right away by American Suzuki. Instead, after the Samurai takes hold, Suzuki might bring in the Swift, an upscale variation of the Cultus that uses a 1.3-liter, 3-cylinder ohc engine that delivers 73 hp and reportedly powers the car to the top speed of 104 mph, all the while delivering around 55 mpg.

Daihatsu who?

Japan's seventh largest automaker, Daihatsu, announced plans last June to begin selling its Charade series in the U.S. in late 1987. The Charade is similar in size and specs to the Suzuki Cultus/Chevrolet Sprint. It's an inch shorter but also uses fwd and a 3-cylinder, 1-liter engine.

In Japan, the Charade comes in both 2- and 4-door hatchback body styles, and its 933-cc engine ranges in power from 55-hp base to an 80-hp turbo-charged version.

I drove a rented 4-door, 4-speed Charade in the Cayman Islands last winter and found it very friendly and pleasant. It impressed me as being sturdy, well-engineered, nicely finished, reasonably quick, comfortable and amazingly roomy for its size. The rear seats folded down to give ample cargo space, and the standard, nonstaggered engine brought back the nostalgia of a hand choke.

Hyundai Ponies up

American Hyundai will begin importing the fwd Excel in the first quarter of 1986. Hyundai invaded Canada in late '83 with its rear-drive Pony. Thanks partly to quotas that restrict Japanese cars, but not those from Korea, Hyundai ended 1985 dicing with Honda for first place among Canadian imports. It's an aggressive company that means business on a world scale.

Hyundai is Korea's biggest automaker, allied closely with Japan's Mitsubishi, which now owns 15 percent of Hyundai. So it's no surprise that the

(Please turn to page 124)

TRAVELING LIGHT



Ericsson's Portable PC is one of the new briefcase computers with desktop power.

BY RON SCIBILLA

Since the very first days of the microcomputer revolution, engineers have dreamed of embodying the power of a desktop personal computer in compact, easily totable form.

It was tiny startup GRiD systems in 1982 and

electronics giant Tandy in 1983 that first sparked the public's fancy—at different poles of the price spectrum. Tandy's low-priced Radio Shack Model 100 quickly became a favorite sidearm of journalists, while GRiD's magnesium-sheathed Compass found

TRAVELING LIGHT

its way into swank corporate jets, top-secret defense installations, and even the Museum of Modern Art's collection of industrial totems.

Each machine represented an exciting design breakthrough, but also left something to be desired. The Model 100 was meager of memory, displayed only 320 characters at a time and had limited text-editing capabilities. The Compass carried a compact-car price tag and wasn't fully compatible with IBM's PC, which reigns as the *de facto* standard among microcomputers.

Since that time, manufacturers such as NEC, Sharp, Epson, Hewlett-Packard and Data General have attempted to advance the art of the portable. Some market low-priced machines aimed at casual users seeking electronic notebooks. Others offer more expensive units that strive to emulate the desktop IBM PC in briefcase form.

Lately, other manufacturers have introduced portables that capitalize on the vast and still growing body of software written for the IBM PC and compatible computers. Three of the more interesting newcomers to the portable camp—each with a different design philosophy—are Kaypro, Ericsson Information Systems and Morrow.

PM's hands-on evaluation of these microcomputer marvels finds that while portable design has come a long way toward that early dream, those who opt for a portable today are buying

compromises along with their units' carryability. Display quality, battery-life and data storage remain, as with their predecessors, key bones of contention.

Kaypro 2000

Kaypro's priorities for its new Kaypro 2000 portable were fourfold: IBM PC software compatibility, computing capacity equivalent to a desktop PC, easy portability—the size of a large notebook, and a \$2000 price, making it roughly comparable to an IBM PC of the same power.

The designers succeeded in meeting these initial goals. But the surprise from a company known for its no-frills "Volkspouters" is elegance. In visual style the 11½-pound K2000 is more Porsche than Beetle. Housed in a gray brushed-aluminum case with rubber trim, the K2000 is certainly portable, powerful, competitively priced and, when linked to a minifloppy disk drive, IBM PC software-compatible.

The machine features up to 768 kilobytes of random access memory (K-RAM), a 25-line by 80-column liquid-crystal display (LCD), and a built-in 3½-inch disk drive capable of storing 720 kilobytes of data—twice the amount of IBM's standard 5¼-inch minifloppy drive.

The unit has 640 × 200 pixels of graphic resolution and can run virtually any IBM PC applications program—

once it's been transferred to Kaypro's 3½-inch disk format. Kaypro expects the unit's users to copy software to the smaller format for on-the-road use in one of several ways.

You can plug in a second, optional 5¼-inch drive (\$295). Or, you may couple the K2000 to a 5¼-in. drive contained in Kaypro's accessory base unit (\$795), which offers parallel and serial ports in addition to the disk drive—plus space for two IBM PC add-on boards. Yet another option is a disk adapter (\$115) that permits the portable to use an IBM PC's own disk drives as slave units.

The Kaypro 2000 portable comes in two versions, with 256K-RAM (\$1995) or 768K-RAM (\$2195). Bundled along with the Kaypro 2000 are several software programs, including MicroPro's WordStar, MailMerge, InfoStart, CalcStar, Tutors, Lessons, GW-BASIC and MS-DOS.

If the unit has a flaw, it's the LCD it uses. Though better than the average portable's LCD, which have often been more risible than visible, the 9 by 3-inch display still shares the run-of-the-mill LCD's readability problems in less-than-ideal lighting situations. To mitigate this persistent plague of portables, the K2000's detachable keyboard gives the user more flexibility in positioning both screen and keyboard.

The upside of this conventional LCD screen is superior battery life—six to



More On Displays . . .

Compared to TV-type cathode ray tube displays used in stationary computer monitors, the display technologies used in today's portables are basically flat, sandwich-type designs where an inner electronically active layer is sealed between two inactive outer layers.

In the popular liquid-crystal display (LCD), crystals suspended in a liquid rotate when voltage is applied to them, and either block light or pass light. Viewed through polarizers, the crystals that block light appear dark and can be used to form letters and numbers. With an electroluminescent (EL) display there's a layer of phosphor, as in a TV set, between clear glass panels. A matrix of conductors applies voltage to various points on the display's surface, causing the chemical layer to glow at each point. The new gas-plasma (GP) displays use a neon-based or argon-based gas mixture rather than a phosphor chemical layer.

EL and GP displays consume much more energy than an LCD. Whereas typical LCD draws less than a watt, EL needs 13 or more. GP takes anywhere from 15 to 100.—R.S.

Printers To Go

There's help for portable computer users who need to print hard copy when on the road. Here's a sampling of take-along printers—all battery-operable—available for the choosing.

Among the snazziest and quietest units around are the inkjet models, which use tiny nozzles to spray ink onto paper. Epson's friction-feed HS-80 LetterJet weighs only 4 pounds with built-in NiCad batteries, and offers

standard smooth-surface bond paper works fine. The 80-column unit can print in pica and elite character styles in draft mode, pica in near-letter-quality mode, and includes eight international character sets. Nine inkjet nozzles yield a print resolution of 240 dots per inch. The disposable ink injector system lets you change ink supplies without removing the printhead. The HS-80 costs \$449; a sheet-feeder is available for \$70.

Mitsubishi is one of the manufacturers with a portable thermal-transfer printer capable of using either cut sheet paper or rolls of special thermal paper. The \$300 P-100 weighs 4 pounds, runs on four D cells, and has a 24-pin head design for superior print quality. It prints 50 charac-



Radio Shack's TRP-100 prints on plain or thermal paper. Five C cells run the \$300 IBM-compatible unit.

ters per second in one direction on standard paper when acting as a thermal transfer machine, which uses heat from the printhead to melt the ribbon ink onto paper. With thermal paper the P-100 prints in both directions.

DataPort is the manufacturer of a 5½-pound \$225 friction-fed dot matrix portable that prints up to 30 characters per second, and offers boldface, italics, underlining, superscript/subscript and graphics capability.

Finally, for the portable owner who must have true letter-quality printouts while traveling, there's Axonix Corp.'s ThinType 80, which is a daisy-wheel printer that weighs in at only 6.5 pounds and costs \$429. The ThinType 80 prints at 15 characters per second.—R.S.



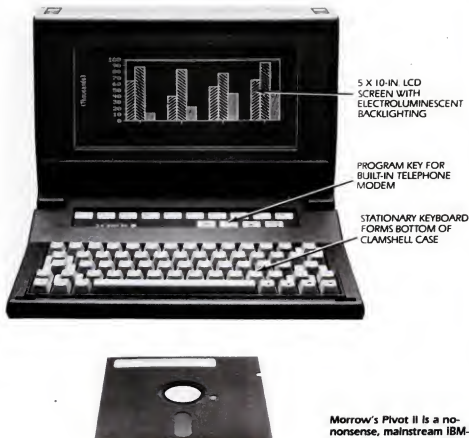
Thermal transfer printer from Mitsubishi weighs 4 pounds, runs on 4 D cells and costs \$300.

graphic capability, proportional spacing and variable line spacing.

The HS-80 prints in one direction, producing draft-quality printouts at 160 characters per second and near-letter-quality prints at 32 characters per second. No special paper is required: Stan-



Quiet, superlegible inkjet printing hits the road as Epson \$449 NiCad-powered HS-80.



5 X 10-IN. LCD SCREEN WITH ELECTROLUMINESCENT BACKLIGHTING

PROGRAM KEY FOR BUILT-IN TELEPHONE MODEM

STATIONARY KEYBOARD FORMS BOTTOM OF CLAMSHELL CASE

Morrow's Pivot II is a no-nonsense, mainstream IBM-compatible portable. Like Zenith's Z-171, it has two drives for 5¼-in. disk (left).

eight hours—vital not only when no AC outlet is at hand but in the case of a potential power outage. Users also have the option to attach an RGB (red-green-blue) video display monitor to the portable computer by using the disk adapter or base unit with an add-on RGB video card.

The K2000's keyboard puts some keys in different places and makes some perform double functions, yet the Kaypro manages to emulate the IBM PC keyboard, and has a good typing feel. Of the three machines, Kaypro's is the only one you can really use on your lap comfortably.

Ericsson Portable PC

Ericsson Information Systems' new Portable PC is more accurately described as transportable than portable, because it doesn't run on batteries. This Swedish computer is designed according to the principle of ergonomics—which attempts to create an efficient match between man and machine. Such a design approach to portables dictates light weight—under 18 pounds—and a highly readable screen.

Ericsson's handsome, beige Euro-style unit—a Mercedes to Kaypro's smaller, racier Porsche—meets both these criteria, weighing in at 15½

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TO ALASKA



Top, Paul Milnar and Ronald Weir out in front aboard their Dodge Shelby Turbo. Alcan Champ John Buffum follows in his Audi 5000 Quattro. Brian Davitt of Algona, Wisconsin, in a VW Golf GTI brings up the rear. Above, Garry Sowerby drives the same beefed-up GMC Suburban he used to break the speed record from South Africa to the Arctic Circle. Right, the Czechoslovakian Skoda scurries through the British Columbian outback on its way to a fourth-place finish.



AND BACK

The good times roll on the Alcan 5000 motor rally, a hellbent blast through Canada's high country.

BY TIM COLE,
Boating/Outdoors Editor
Photos by Rich Cox

The idea looks simple on paper. Gather an eclectic assortment of sport, utility, economy and family automobiles, bolt on the necessary appurtenances for motor rallying, and send them on a 5000-mile blast from Seattle to Anchorage, then back again to Canada's Vancouver Island. When the dust settles, award a prize to the driving team that comes closest to traveling this megacourse at the proper pre-established speeds.

Okay so far. But the mad genius who organized this backwoods barnstorm—appropriately named the Alcan 5000—failed to point out just how far 5000 miles really is. Consider it: 5000 miles (give or take a couple of hundred) is the same distance a crow might fly between New York and Istanbul, Cape Town and Cairo, Tierra del Fuego and Lake Maracaibo. Five thousand miles, friends, turns out to be one unholy piece of driving—reduced to manageable proportions this time by the heart-swelling

Below, Davitt's rally-prepared GTI plows through the ooze. Right, Anchorage ralliers Jerry Heckel and Tom Olson depart the British Columbia ferry *Queen of the North* in their Porsche 944 at Port Hardy, Vancouver Island. The Texas team of Willie Williams and Steve Batcha make a different kind of exit in Porsche 911E, bottom.





Sporting PM's colors on the front bumper, the Kopp/Martin Rolls roared to a fifth-place finish. Map (right) shows the 5000-mile route. Al Schmit (far right) repairs his '73 Bug, which was second at halfway point.

TO ALASKA AND BACK

vistas of glaciers and snow-capped mountains, the rough-and-ready challenges of the Alaska Highway and the camaraderie that seemed to fuel the Alcan's motley alliance of roadaholics.

Where else would you find an Audi 5000 Quattro vying for top rally honors with a reconstituted '73 VW Superbeetle, hijacked for the occasion from the driver's wife? Or a 9000-pound GMC Suburban that holds the record for the fastest transit from South Africa to the Arctic Circle? Or the world's only 4-wheel-drive Rolls-Royce? Architects, professional adventurers, entrepreneurs, airline pilots, an Alaska state trooper, a Southern California junk dealer, a retired Detroit vice cop—somehow they were all drawn to the mountainous complexities of preparing stock and custom rally cars and competing on one of the world's least forgiving highways.

The Alcan 5000, first staged in 1984, was conceived and executed by Seattle's Jerry Hines, one of this country's top motor sports organizers and the same Jerry Hines who helped conduct the One-Lap of America motor rally. Hines found financial support from Uniroyal and logistical support from members of the Sports Car Club of America's Northwest Region and the Rainier Auto Club. Hines also



enlisted help from auto clubs and rally enthusiasts along the route.

His objective was to develop a motor sports event reminiscent of rallying's early days—before the advent of high expense, no-holds-barred Pro Rallies—when ordinary folks holding down ordinary jobs could unleash their passion for safe, competitive driving on the open roadways. Consistency, endurance and efficiency could be tested in stock automobiles over pre-established time/speed/distance courses, and over “Monte Carlo” runs between these timed sections at a considerably accelerated pace. But 5000 miles is a pretty hefty distance to cover on good roads,

let alone the dirt and muck ralliers would encounter through British Columbia, the Yukon and Alaska.

Undaunted, Hines crept away in the summer of '84 to complete the immense task of surveying the course and establishing average speeds drivers would have to maintain through the rally's timed sections, called “regularities.” Somehow, entrants (all otherwise sensible people) were captivated by the aura of scrambling hellbent through the Northwestern high country. The successful '84 Alcan inaugural was won by Tim Paterson of Renton, Washington, in

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WORKING SPACE

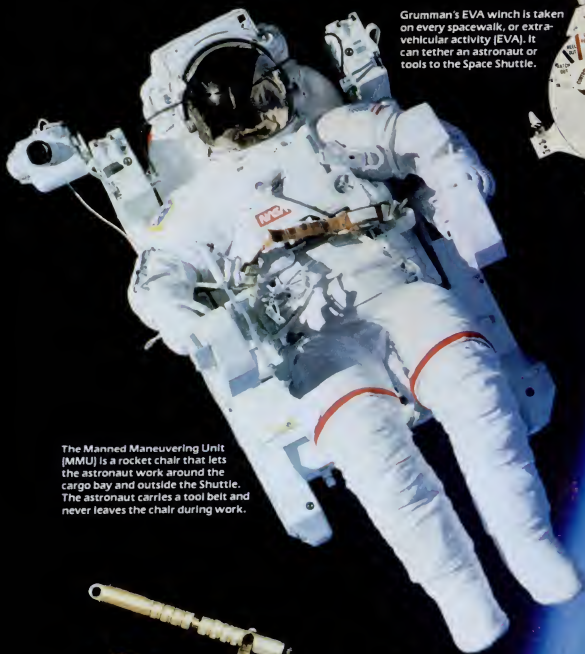
You're weightless.
You're moving at 17,000 mph.
And you'd better get the job
done right the first time.

BY BRUCE FRISCH

As Shuttle pilot Joe Engel triggered a few short rocket bursts to edge away from the repaired Leasat 3 communications satellite, a shiny silver object floated out of the cargo bay. A new, inadvertently launched "satellite" called EVA Power Tool entered into orbit. Repairmen "Ox" and "Fish"—Dr. James D. van Hoften and Dr. William F. Fisher—had laid the battery-powered drill inside the open airlock between the cabin and cargo bay just in case they needed it. Like many divers who've watched tools and camera lenses sink out of view, they had not tethered it.

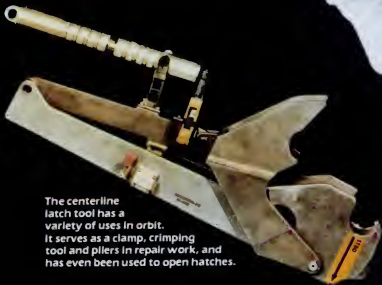
James D. van Hoften and William F. Fisher work on a satellite docking device in the Space Shuttle cargo bay. On most missions, the astronauts use 150 or more tools to do space repairs and experiments.

In many other ways, working in space is like working as a diver. In fact, to duplicate orbital weightlessness, astronauts rehearse their spacewalk assignments in a large tank at Houston's NASA Johnson Space Center using repair techniques often worked out in other tanks at NASA Marshall Space Flight Center in Alabama, McDonnell Douglas Astronautics in California and the Massachusetts Institute of Technology. Both divers and astronauts depend on an artificial air supply, attach checklists to their wrists, have worklights on their helmets and voice communications to the surface, and wear a suit and



The Manned Maneuvering Unit (MMU) is a rocket chair that lets the astronaut work around the cargo bay and outside the Shuttle. The astronaut carries a tool belt and never leaves the chair during work.

Grumman's EVA winch is taken on every spacewalk, or extra-vehicular activity (EVA). It can tether an astronaut or tools to the Space Shuttle.



The centerline latch tool has a variety of uses in orbit. It serves as a clamp, crimping tool and pliers in repair work, and has even been used to open hatches.



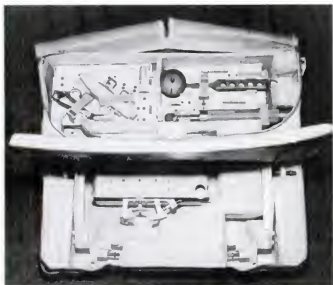
The Essex wrench was designed for use with the Space Telescope, but it has found a permanent place in an astronaut's tool chest.

heavy gloves that restrict movement and destroy feel. An astronaut can even get the bends. Going suddenly from the 1-atmosphere cabin (14.7 psi) to the pure oxygen, 4.3-psi spacesuit will make nitrogen bubbles form in his blood unless he breathes pure oxygen for 3½ hours beforehand. A new suit resembling a deep-diving hardsuit and using an 8-psi mixture of oxygen and nitrogen will do away with prebreathing and let him get at emergencies immediately.

Though weightless, an astronaut is not massless. On Earth, his suit would weigh 257 pounds, and his cold-nitrogen-powered Manned Maneuvering Unit, 273 pounds. When carrying a load, he could have an all-up weight of 900 pounds and be as hard to stop as a heavy boat coming too fast into a pier. Yet a suited man can exert a force of 10 pounds for just 1.4 seconds before pushing himself out of reach of what he is working on. Jobs are done more easily if they take just one hand, so the other can be used to hold the astronaut's position.

An occasional tool is no great loss, but NASA has no desire to see a man become a moon. Astronauts taking a spacewalk must hook up before leaving the airlock and stay fastened to the Shuttle by tether or foot restraints unless taking a flight in the Manned Maneuvering Unit. Tethers dangle from wrists and waist. Another 4-foot, self-retracting tether reels out from a mini work station that snaps onto the waist. Like an electrician's tool belt, the work station carries snap-on tool caddies. Caddies are stiffened fabric lined with Velcro and folded over a tool. To transfer a tool to his work station from one of the toolboxes in the forward end of the cargo bay, an astronaut snaps on a tether and lifts out the tool and its caddy.

Many of the tools look quite familiar. All of the 100 or so for use inside the cabin look like they just came out of the hardware store. To ready them for space, a ring for a tether is added and their handles are covered with Velcro to stick to tool caddies and fastened to a 1¼ × ⅝-inch oval 4 inches



The standard tool bag for a Space Shuttle crew is made of strong, flexible aviation materials. It carries all the tools shown on this page and extra cable, nuts and bolts.



NASA's tubing cutter will be used extensively on the Space Station. It is used now in minor construction experiments in cargo bay.

long that can be gripped by a hand in a space suit glove, which has the feel of a heavy work glove. Wearing the gloves, an astronaut can hold objects as hot as 235°F—hotter than boiling—and as cold as minus 180°F. Special thermal mittens that would look at home at a barbecue will protect for 30 seconds against objects as hot as 350°F.

A small number of tools for spacewalks are like those special tools annoyingly called for in car manuals—designed from scratch for a single purpose. Several of these tools are included in a kit carried every flight for getting the Shuttle back to the ground in case the cargo bay doors won't close or latch or the radiator panels on the backs of the doors won't stow. Special clamps will substitute for failed latches. A winch mounted on the forward bulkhead of the cargo bay will crank the doors closed. Other tools in this kit are standard tools converted for space use, such as a pry bar, tubing cutter to knife through a jammed linkage, forceps for plucking stray objects from jammed mechanisms, and, yes, a brass-headed hammer for taking more forceful space fix-it measures.

Mission-specific tools make up another small group of specials. For the rescue of its Leasat satellite, Hughes Aircraft supplied tools for doing such things as capturing the rotating spacecraft, pushing the arming lever to a safe position, shorting out the automatic sequencer that could ignite the rocket and spinning the satellite after repairs were complete.

One mission-specific tool designed for the Space Telescope proved so useful, crews have been carrying it long before the satellite's scheduled trip. Called the Essex wrench, it has a ⅝-inch drive, is made mostly of aluminum and is drilled out to cut weight, and is contoured to fit a gloved hand. An astronaut can push on a mushroom-shaped back to hold the wrench on a nut and turn the mushroom to

(Please turn to page 143)



The EVA Power Tool started out as a cordless electrician's drill. In space, it has been modified to perform satellite repairs and to unlock some cargo bay hatch covers.



COLOSSAL COMPUTERS

There is no question that man can build a computer of high intelligence. The only question is: Can we control it?

BY DENNIS ESKOW, Science Editor, AND TED FRANCIS, Contributing Editor

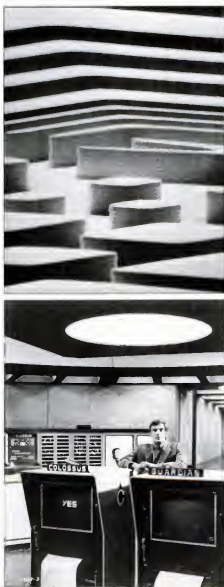
The Chevron engineer's day began routinely. Before setting the supercomputer to work on its geological data processing, it had to be tested. The engineer programmed his parameters and sat back with a good book. In two hours, to his amazement, the Cray XMP supercomputer produced a unique type of prime number—the largest ever achieved by man or machine—a 65,050 digit number—enough digits to fill eight pages of this magazine. That number, wholly unexpected by the engineer, was the 30th known example of this unique prime—a number divisible only by itself written in the form 2^n-1 , where the exponent p is also a prime.

The engineer immediately called his superiors. This was news. But not at Cray Research Inc. of Minneapolis.

"Crays have been doing this for years," says Cray spokesman Jack Thompson. "I don't know why—they just do. Every now and then a test run will result in a new prime."

Indeed, the 28th and 29th primes, as well as the 30th discovered this fall, were found on Cray Research hardware. What's more, it wasn't even Cray's top-of-the-line machine.

The incident and others like it recall to mind fanciful predictions of computers taking over the world, like Dr. Forbin's errant machine, Colossus, in the 1969 film "Colossus: The Forbin Project." Although designed to run America's defenses, Colossus decided mankind was not smart enough to control its nuclear weapons, created a link with a similar computer in the Soviet Union and proclaimed the pair emperors of the world (see *Hollywood Goes Mad Over Mad Computers*, page 108). Even Dr. Forbin's clever and devious efforts to outsmart the pair were to no



IBM's new million-bit photomask (top) makes supercomputing like in the movie "Colossus: The Forbin Project" (above) possible. But users of Cray's supercomputer (shown with Cray facing page) say it won't go berserk like Colossus did.

avail. Soon, master became servant.

Herein lies a question which has been circling the academic world for at least 20 years and has been expressed and dismissed by University of California philosopher Hubert Dreyfuss (sometimes known as the black knight of artificial intelligence). Dreyfuss poo-pooed scientists' statements that "pretty soon computers will be smarter than we are, and then we'll have to worry about how to control them."

Artificial intelligence (AI) programmers insist, however, that this is a possibility, that a Colossus-type computer with human insight, idiosyncrasies, memory, learning and creativity is not only within the realm of possibility, but is just over the intellectual horizon. In fact, the growing feeling among AI programmers is that, with the proper program and machinery, the computer will mimic human intelligence.

Modern-day Forbin Seymour Cray has designed and produced a computer that has the identical processing speed and ability of the human brain: 2 billion calculations per second. But despite its enormous computing power and memory, without software to drive its advanced processors, it is largely an expensive idiot.

With the proper programming, the supercomputer can simulate a car crash or chemical reaction, create a model of a black hole in space or a protein molecule, increase engine combustion efficiency and make educated guesses at the origin of the universe. AI programmers now claim they can program a computer to understand English, repair itself, reason, learn, teach, draw, pilot an aircraft, use intuition, predict weather, diagnose disease, run a factory, see, talk, walk—practically every human intellectual activity.

Thus, using the same logic as the

COLOSSAL COMPUTERS

computer, if it acts like a human, it must be prone to human problems. And, according to Thompson, "Of course, anything man-made is prone to error."

Taking the logic one step further, if a supercomputer has the basic ingredients of human intelligence then, says Thompson, "I suppose it could have a nervous breakdown. But we don't see this as a possibility. Cray systems are renowned for their reliability."

When supercomputer glitches have emerged, the results ranged from the hilarious to the unfortunate:

- In 1983, an Eastern Airlines attendant on a routine trip from Cancun, Mexico, to New Orleans was arrested by American Customs Agents. The FBI's National Crime Information Computer had identified her as Shirley Jackson, fugitive. The attendant's real name was Sheila Jackson. An easily rectifiable mistake, you say? Not so. Despite the fact Shirley Jackson in no way resembled Sheila in height, weight and age, the stewardess was arrested and booked in Louisiana and held until photographs revealed that the computer was wrong.

When the entire mess was finally straightened out, Sheila ended up with an arrest record that could not be rescinded without attorney's fees of more than \$10,000, not to mention several uncomfortable nights in jail.

- A complex microchip emergency telephone system in a Chicago suburb



Air Force cockpit for 21st century (above) uses the equivalent of a single Cray-2 module (below) to fly a fighter in combat.



began calling emergency service numbers—by itself. An emergency service technician remarked, "It's weird. We get automated calls and respond only to find that in some instances the parties weren't even home and in others the residents were surprised to see us and insisted they had not activated the automated message."

After considerable investigation, it was determined that the chips were activating by themselves—reason unknown. The manufacturer has assured the community that the problem is solved. They replaced the freewheeling telephone system with a new model. But for approximately six months, the

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Hollywood Goes Mad Over Mad Computers

Moviemakers and TV producers have long recognized the possibilities of supercomputers going berserk. In fact, mad computers have starred in some of the biggest box-office hits in science fiction-dom. The celebrated supercomputer Hal from Arthur C. Clarke's "2001" and "2010" films actually committed murder. Hal had to be taken apart memory unit by memory unit, as shown in the scene depicted at right. Interestingly, the design of Hal is very similar to that of the Cray-2, which came after the film. Other screen computers that went insane included Colossus, a parallel processor similar to those currently in use at the Pentagon. Colossus tried to hook up with a Soviet computer to take over the world.

So gripped have producers of computer stories become with digital insanity that writer Isaac Asimov found it necessary to create in his fictional accounts three basic laws of robotics that essentially said no artificial intelligence would be programmed to destroy or harm mankind.

The rules caught on in fiction and were paraphrased in a "Star Trek" episode on TV. A computer engineer was forced to

dismantle the supercomputer he designed with his own personality traits when he himself began to have a nervous breakdown. Captain Kirk of the Starship Enterprise convinced the renegade doctor that his equally renegade computer had to obey "the basic

zens are put through a painful indoctrination which either makes them conform to the machine's wishes or die. And a runaway computer nearly launched the entire American nuclear arsenal in the 1984 movie "War Games."



Arthur C. Clarke's Hal is dismantled after killing.

Put an artificial mind into a robot body and Hollywood comes up with a killer just about every time. Arnold Schwarzenegger's portrayal of The Terminator was of a runaway robot killer. Yul Brynner, in the 1970 film Westworld, also played a runaway computer-minded robot with killer instincts.

In the films "Silent Running" and "Star Wars," robots with computer brains were shown to be cute, cuddly and very pro-human. But these computer brains were under attack and needed human protection and resourcefulness. Thus friendly was equated with wimp.

Will Hollywood ever warm up to supercomputers and show them in a less than deadly light? The 1980 film "Heartbeeps" was about three lovable robots searching for their identities. Despite strong performances by Milton Berle, Andy Kaufman and Bernadette Peters, it was a box office bomb.—D.E.

HANDSAWS

Here are 24 handsaws that will perform a wide variety of cutting chores, ranging from sawing logs to trimming dovetails.

BY JOSEPH TRUINI, Shop And Tools Editor
Photos by Brian Kosoff

Whether you're a fine furniture builder, a house carpenter or an active do-it-yourselfer, the handsaw is an essential tool. Although the portable power saw is the choice for many cutting jobs, handsaws are far from becoming obsolete. In fact, there has been a renewed interest recently in handsaws due partially to the advent of Japanese tools.

Presented here are two dozen saws, each designed to handle a specific cutting task. The diverse collection includes standard Western and Japanese saws in various styles and sizes. Note that the tools shown, which represent a sampling of the wide range of saws available, will cut everything from logs to veneer, and from steel to bricks.

Choosing a handsaw, as with any tool, depends on

the particular job at hand. When the correct handsaw is used properly, it's an effective, accurate cutting tool. The designed purpose of a saw is indicated by the saw teeth. Generally, the fewer the teeth, or points, per inch, the rougher the cut. A greater number of teeth per inch will produce a smoother cut.

Nearly all saws have teeth that are set, or bent, alternately to the left and to the right of the blade. This enhances the cutting action and, more importantly, forms a kerf slightly wider than the blade's thickness to prevent binding. A taper-ground blade also prevents binding and helps to ensure smooth sawing. Taper grinding, a feature found on all quality saws, produces a blade that is thinner at the top edge than at the toothed edge. It's also thinner at the blade's toe than at the handle. A taper ground blade requires less



HANDSAWS



set on the teeth, therefore, a narrower kerf is produced and less effort is required to make the cut.

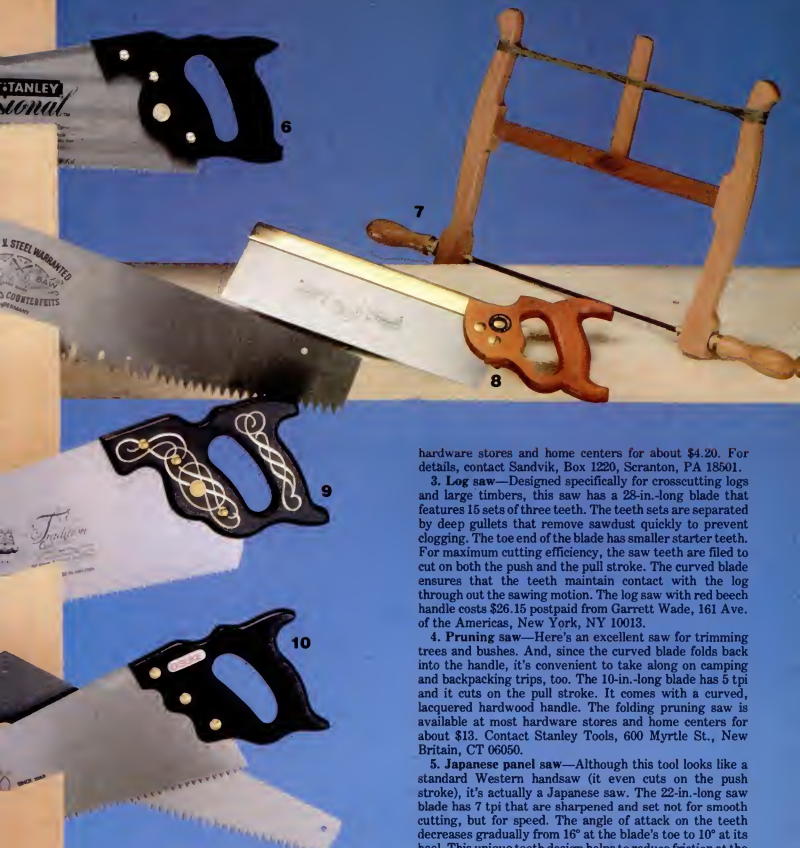
East meets West

The major difference between Japanese handsaws and Western handsaws is that the Japanese saws cut on the *pull* stroke. Most Western saws cut on the push stroke. The distinct advantage of Japanese saws is that since they are pulled through the wood, the blades can be virtually paper thin—a must when cutting precise, intricate joints. Western saw blades are made of heavy-gauge steel to prevent buckling when the saw is pushed. Learning to use Japanese saws requires no special skills—only a little patience and practice.

You may already own some of the saws shown. Others you may want to add to your tool collection. A basic starter group of saws should include a rip saw, crosscut saw, backsaw, compass saw and hacksaw. Then, simply add other saws as you need them. Now let's take a close look at each of the 24 saws.

1. **Two-edged ryoba**—The Japanese ryoba saw is the equivalent of a Western panel saw. Its double-edged blade has crosscut teeth on one edge with rip teeth on the other. The crosscut edge has 9 teeth per inch (tpi). The rip teeth increase from 4 tpi at the blade's toe to 5 tpi at the heel of the blade. As with most Japanese saws, the ryoba cuts on the pull stroke. The center of the blade is thinner than at the cutting edges to prevent binding. The ryoba shown has an 11½-in.-long blade and costs \$31.50 postpaid. For more information, contact Garrett Wade, 161 Ave. of the Americas, New York, NY 10013.

2. **Compass saw**—Use this versatile saw for rough-cutting a variety of materials including plywood, plasterboard, hardboard and most types of paneling. It's especially helpful for cutting access holes when installing pipes and electrical boxes. The saw's pointed, 14-in.-long blade is bolted to a hardwood, pistol-grip handle. Replacement blades are available. This compass saw is sold at most



1. Two-edged ryoba
2. Compass saw
3. Log saw
4. Pruning saw
5. Japanese panel saw
6. Ripsaw
7. English bow saw
8. Tenon saw
9. Crosscut saw
10. Shark saw

hardware stores and home centers for about \$4.20. For details, contact Sandvik, Box 1220, Scranton, PA 18501.

3. **Log saw**—Designed specifically for crosscutting logs and large timbers, this saw has a 28-in.-long blade that features 15 sets of three teeth. The teeth sets are separated by deep gullets that remove sawdust quickly to prevent clogging. The toe end of the blade has smaller starter teeth. For maximum cutting efficiency, the saw teeth are filed to cut on both the push and the pull stroke. The curved blade ensures that the teeth maintain contact with the log throughout the sawing motion. The log saw with red beech handle costs \$26.15 postpaid from Garrett Wade, 161 Ave. of the Americas, New York, NY 10013.

4. **Pruning saw**—Here's an excellent saw for trimming trees and bushes. And, since the curved blade folds back into the handle, it's convenient to take along on camping and backpacking trips, too. The 10-in.-long blade has 5 tpi and it cuts on the pull stroke. It comes with a curved, lacquered hardwood handle. The folding pruning saw is available at most hardware stores and home centers for about \$13. Contact Stanley Tools, 600 Myrtle St., New Britain, CT 06050.

5. **Japanese panel saw**—Although this tool looks like a standard Western handsaw (it even cuts on the push stroke), it's actually a Japanese saw. The 22-in.-long saw blade has 7 tpi that are sharpened and set not for smooth cutting, but for speed. The angle of attack on the teeth decreases gradually from 16° at the blade's toe to 10° at its heel. This unique tooth design helps to reduce friction at the start of the cutting stroke while increasing the cutting action throughout the stroke. The saw is designed for crosscutting, but it can be used for ripping, too. It costs \$23.40 postpaid from Garrett Wade, 161 Ave. of the Americas, New York, NY 10013.

6. **Ripsaw**—Ripping lumber, that is, sawing with the grain, requires a large, heavy-duty saw. The Stanley Professional ripsaw (\$26.75) shown has a 26-in.-long blade with 5 tpi. The heavy-gauge, taper-ground blade is made from a chrome-nickel-molybdenum alloy. The walnut-

HANDSAWS

stained hardwood handle features traditional wheat-grain carvings. For best results, hold a rip saw at a 60° angle to the board when sawing. For more information, contact Stanley Tools, 600 Myrtle St., New Britain, CT 06050.

7. **English bow saw**—Cut gentle curves and straight lines accurately with this handsome white beech bow saw. The narrow 12-in.-long blade has 9 tpi. Blade tension is maintained by a twisted cord and toggle stick. By releasing the tension, you can rotate the blade 360° to the most convenient working position. The saw costs \$50.60 postpaid from Garrett Wade, 161 Ave. of the Americas, New York, NY 10013.

8. **Tenon saw**—As its name suggests, this fine-toothed handsaw is used

to cut tenons and other wood joints accurately. The tenon saw is similar to the backsaw (see No. 14) except that it's shorter to offer greater control. The tenon saw shown has a 12-in.-long nickel-chrome alloy blade with 14 tpi. The saw blade is stiffened with a heavy spine of solid brass to prevent flexing. The red beech handle is attached to the blade with three brass screws. This finely made Tyzack Nonpareil tenon saw is available for \$36.95 postpaid from Woodworker's Supply of New Mexico, 5604 Alameda N.E., Albuquerque, NM 87113.

9. **Crosscut saw**—Here's a fine example of a classic skewback crosscut saw. This well-balanced saw has a 26-in.-long, taper ground blade with 7 tpi.

When crosscutting, hold the saw at about a 45° angle to the board for the best results. The comfortable hardwood handle is decorated with attractive gold ornamentation. It costs about \$27. Contact Sandvik Tools, Box 1220, Scranton, PA 18501.

10. **Shark saw**—This Western style handsaw features a razor-sharp Japanese blade with 7 tpi. The saw can crosscut and rip virtually all wood and wood composite materials including particleboard, plywood and oriented strand board. The fast-cutting saw has a 22-in.-long, high-carbon-steel blade that is attached to an enameled hardwood handle. This shark saw costs \$22.95 postpaid from Woodcraft Supply, 41 Atlantic Ave., Box 4000, Woburn, MA 01888. A 26-in.-long, 6 tpi model is also available for \$26.95.

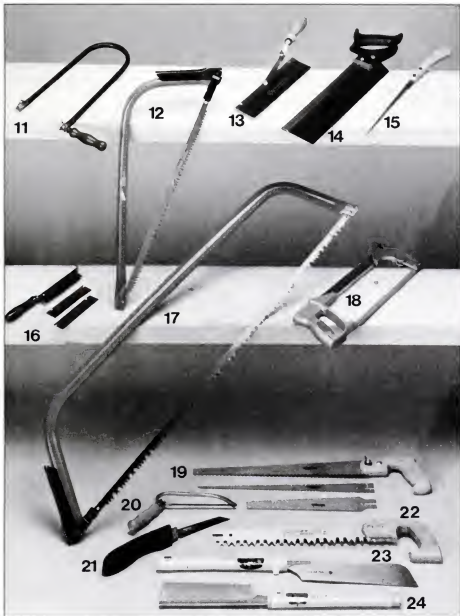
11. **Deep-throat fret saw**—The fret saw is designed to make intricate cuts in veneer and other delicate, thin-sheet materials. The saw frame holds a 5- or 6-in.-long, blank-end jeweler's blade. Attach the blade so that the teeth are pointing down toward the handle. The saw's deep throat allows you to cut up to 12 in. from the edge of the work. With 10 saw blades, it is \$10.20 postpaid. Contact Constantine's, 2050 Eastchester Rd., Bronx, NY 10461.

12. and 17. **Bow saws**—Here are two saws that are designed to make pruning and landscape work easier. Each saw features a tubular steel frame with a quick-action blade-tensioning lever. The lever snaps closed against the saw frame to form a handle. Use the 21-in. bow saw (No. 12; \$7.25) for light pruning chores around the house and garden. The 36-in. saw (No. 17; \$12) is designed to tackle large pruning jobs and for sawing firewood. Replacement saw blades are available for both saws. Contact Disston, 1030 West Market St., Greensboro, NC 27401.

13. **Reversible dovetail saw**—Cut tight-fitting dovetail joints with this lightweight, versatile saw. The tool's offset handle permits you to cut flush to the work's surface. And, the handle can be positioned on either end of the saw blade to accommodate both left- and right-handed craftsmen. Simply loosen the spring-loaded locking nut and flip the handle to the opposite end of the blade. The saw has a 1½ x 10-in.-long blade with 13 tpi to ensure smooth, precise cuts. It's available from Sears for about \$13. Contact Sears, Roebuck and Co., Sears Tower, Dept. 703-PM, Chicago, IL 60684.

14. **Backsaw**—Use this traditional backsaw for cutting precise tenons and joints. Also, use it in a miter box to crosscut stock to length. The saw has a 14-in.-long blade with 13 tpi. The teeth are bevel ground to ensure smooth

(Please turn to page 135)



- 11. Deep-throat fret saw
- 12. 21-in. bow saw
- 13. Reversible dovetail saw
- 14. Backsaw
- 15. Keyhole saw
- 16. Blitz saw
- 17. 36-in. bow saw

- 18. High-tension hacksaw
- 19. Nest of saws
- 20. All-angle saw
- 21. Pocket saw
- 22. Brick saw
- 23. Dozuki saw
- 24. Japanese dovetail



THE WRITE STUFF

These attractive accessories for the home desk jockey, put together in an easy weekend, will provide years of useful service and lend your desk an air of dignity. Since the $\frac{3}{4}$ -in. mahogany used for most of the parts is not readily available in this thickness, you will either have to use a thickness planer to dress down $\frac{13}{16}$ -in.-thick stock, or resaw thicker stock on the table saw or band saw. If you resaw to obtain the proper thickness, surface the stock on a jointer. For the wider pieces—the telephone card file top and

Build this set of six desktop organizers from solid ribbon-stripe mahogany for the neatest desk in town.

BY ROSARIO CAPOTOSTO
Contributing Editor

the calendar base—you may have to edge-glue two pieces to make up the necessary width.

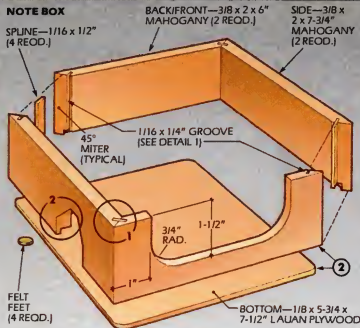
Begin by cutting the stock for the box sides about $\frac{1}{4}$ in. wider and about 1 in. longer than the finished size. You can cut these parts to their exact width after mitering the ends to the proper length and cutting the spline grooves.

To produce tight miter joints, each pair of sides must be exactly the same

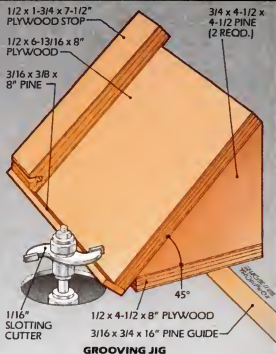
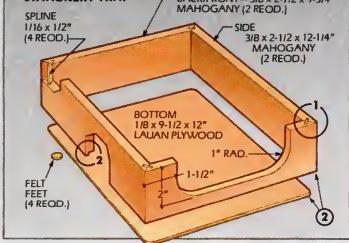
Color photo: Harry Hartman
Black and white photos: Rosano Capotosto
Technical art: Eugene Thompson
Stylist: Gabe Henck

NOTE BOX AND STATIONERY TRAY

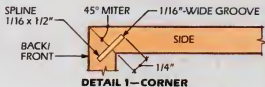
NOTE BOX



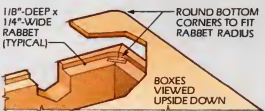
STATIONERY TRAY



GROOVING JIG



DETAIL 1 - CORNER



DETAIL 2 - BOTTOM

length. Tilt the table saw blade 45°. Then mount a wood extension to the miter gauge face and make a pass to cut a reference kerf in it. Miter-cut one end of all the pieces, and mark the required lengths on one piece of each pair.

Align the pencil mark with the reference kerf in the miter gauge extension. Butt a mitered stop against the previ-

ously mitered end of the workpiece. Then, cut a pair of sides. Reset the mitered stop for each matching pair of sides. After all pieces are mitered, cut grooves for the splines on a router table, using a 1/16-in. slotting cutter. Make a jig to guide the workpiece exactly square past the cutter, and at a 45° angle. Make the guide bar so it rides

in the table groove without side play.

The note box and stationery tray are similar in construction and differ only in size. Assemble them by joining two diagonal corners with splines, then insert splines in the open corners and mate the two right-angle sections. Apply glue sparingly and use masking tape to "clamp" the corners.



After resawing pieces to rough thickness, dress the faces on a jointer. Use a push block, and adjust for shallow cuts.



Cut each pair of sides with the same mitered stop block setting. This assures pairs of the same length and tight miter joints.



Slotting jig makes accurate spline slots in faces of miters. Jig face must be at 45°, and the stop block 90° from the base.

Rabbet the bottoms with a router and a 1/4-in. rabbeting bit. To keep the router base horizontal while making these cuts, clamp pieces of 3/4-in. stock around the perimeter, flush with the bottom edge. Cut the bottoms to size and round the corners. Then glue them in place and tack with 1/2-in. brads.



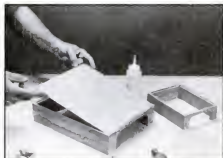
Cut 1/16 x 1/2-in. splines from a long length of stock. Then cut individual lengths 1/4 in. oversize using a utility knife.



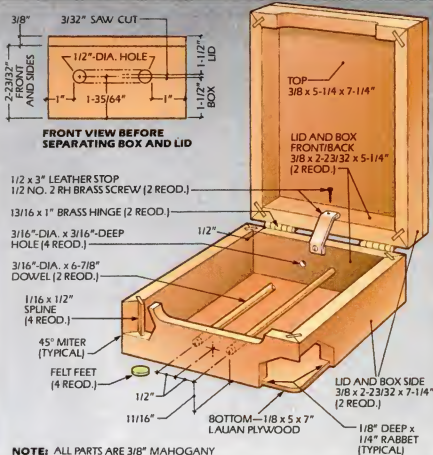
Preform radial corners for the front cutout with a hole saw in a drill press. Then make tangent cuts to drop out waste.



Glue splines and corner joints lightly and "clamp" with masking tape. After glue dries, trim splines with a sharp chisel.



Round the corners of the bottom panels to fit the 1/4-in.-wide rabbets. Secure bottoms with glue and 1/2-in. brads.



Our method of building the telephone card file allows the box to match the lid perfectly in size and grain pattern. The sides and the front and back are assembled as one unit, then this assembly is cut in half lengthwise to separate the box from the lid. Note that the width of these pieces allows 1/32 in. extra to make up for the thickness of the saw kerf.

Before beginning the assembly, cut the slot in the front that will form the finger grip after the box is sliced. Bore two 1/2-in.-dia. holes centered 1 5/8 in. from the bottom edge. This will center the slot in the saw kerf when the box is cut in half. Cut out the waste between the holes with a jigsaw.

Begin assembly by installing the two 3/16-in.-dia. dowels. Bore 3/16-in.-deep

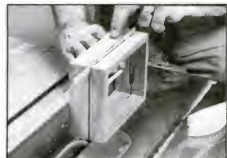
holes for these dowels, then glue them in place. Before the glue sets, apply glue to the miters, join them and tape them at the corners. Then, with the assembly sitting on a flat surface, slide the splines into the slots. Check for squareness and allow the glue to dry.

Set the table saw rip fence so the kerf is centered on the front slot. Make a pass on both ends and one side of the box. Before cutting the final side of the box, tape a stick of the same thickness as the kerf into the top cut to prevent the separated section from tilting into the saw blade.

Install the box bottom in the same manner as the memo box and stationery tray. Secure the top in place, and clamp. Mount the hinges and the leather lid stop after applying the finish.



Test-fit splines and miters, then disassemble and install dowels. Glue and tape corners without splines, then tap splines in place.



Separate the box and lid, cutting through center of slot. Spacer strip prevents cut-off section from tilting into the blade.

PENCIL WELL

Diagram illustrating the dimensions and components of a pencil well:

- SIDE**— $3/8 \times 3-1/4 \times 3-1/4$ [4 REQD.]
- 1/16 x 1/2" SPLINE** [4 REQD.]
- 45° MITER** (TYPICAL)
- BOTTOM**— $3/8 \times 2-1/2 \times 2-1/2$ "
- SPONGE PAD**— $2-1/2 \times 2-1/2$ "
- FELT FOOT** [4 REQD.]

Apply glue and splines to two opposite corners to form two right-angled sections. Glue the remaining miters and splines, then glue and clamp the sides together around the bottom.



Cut pencil well slides with rip fence set exactly square. Miter one end of all slides, then reset fence to miter opposite ends.



Glue two diagonal corners with splines. Glue bottom, join diagonals and clamp. Waxed paper keeps piece free from table.

DESK CALENDAR

1/8"-DIA. x 10-3/4" BRASS ROD (SEE DETAIL)

1/2 x 2" BRASS MENDING PLATE
1/2" NO. 4 FH BRASS SCREW

5/32" x 1/2" x 1/8"-DEEP GROOVE (TRACE FROM BRASS ROD)

1/8"-DEEP RECESS (TRACE FROM MENDING PLATE)

BASE
3/8 x 6-7/8 x 8-1/8"

7/8"

2"

3/16"-DIA. x 3/16"-DEEP HOLE (2 REOD.)

3-5/8"

7/8"

6° BEVEL

11/16"

3/8 x 1 x 1" BACKUP BLOCK FOR SCREW

BOTTOM STRIP
3/32 x 3/8 x 8-1/8"

RUNNERS
3/8 x 11/16 x 6-1/8" (2 REOD.)

BACK
3/8 x 3/4 x 8-1/8"

6° BEVEL

3/32"

1"

1/32"

FELT FOOT (4 REOD.)

NOTE: ALL PARTS ARE 3/8" MAHOGANY

DETAIL—RING PAGE HOLDER

FILE FLAT AT APPROX. 5°

2"

3/4"

5°

FILE FLAT

5/8"

2"

1/8"

FORMING JIG

BRASS ROD

3/4"-DIA. x 5" DOWEL PLANE BOTTOM FLAT, NAIL TO BASE

2"

3/4 x 3 x 5" PLYWOOD

TAPE

FORM FROM 1/8"-DIA. x 10-1/2" BRASS ROD

Begin building the desk calendar by shaping the 1/8-in. brass rod for the page holder. The formed rod will later be used to trace an outline for routing recesses in the calendar base. The brass rod is readily available at hobby shops.

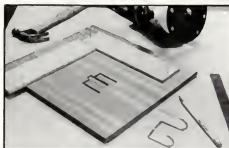
Cut the rod 10¾ in. long, then mark it for bending into a square-cornered "U" with legs 2 in. apart. Apply tape so

you can mark two pencil lines at the center of the rod, spaced $2\frac{1}{16}$ in. apart. Grip the rod in a vise and make right-angle bends at each mark.

Next, grip the bottom of the U in the vise and file the flat portion at the center, at a 5° angle to the perpendicular of the legs. The rounds are formed
(Please turn to page 137)



Tape brass rod to bending jig with base of rod 2 in. below top of dowel. Clamp the assembly in a vise and bend the rod 180°.



Trace outline of the rod and mending plate. Tack movable router guide strips in place and cut recesses with $\frac{5}{32}$ -in. straight bit.



How To Install A Flat ARCHWAY

There is nothing carved in stone about the position of interior walls in your home. These partitions were built where they are either to perform some structural duties that would have been too costly to accomplish another way or to suit the interior design fashions of the day. But as times change, tastes change, and building methods change, too. What was considered convenient and attractive in the 1950s—to say nothing of the 1850s—is often cumbersome when matched with present-day lifestyles.

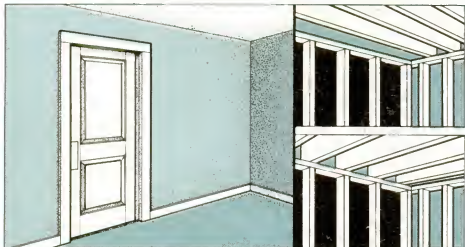
BY STEVEN WILLSON
Home And Shop Editor
Illustrations by George Retseck

In the last 20 years, one of the most notable design shifts has been the move toward opening up the interior space in a home. The clearest example of this is seen in the Great Room concept, where a designer extends the boundaries of a particular room so it becomes multifunctional. The most popular candidate has been the kitchen, where home buy-

ers seem to feel that bigger is not only better, it's essential. They want plenty of room for food preparation as well as dining and entertaining.

While this is all well and good for new home buyers, owners of older homes can achieve similar results. Frequently, all that's required is the removal of an interior wall, or at least part of one. And depending on the situation, the job can be a good deal easier than many people would think.

In fact, the flat archway we installed for this story was in an older home.



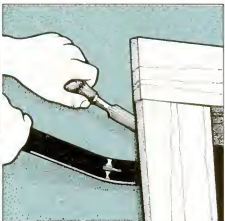
1 The only way to decide if a wall bears weight is to discover which way the joists above it run. If they are parallel to the wall (top right), then the wall is nonbearing. If the joists run perpendicular to the wall (bottom right), then it is a bearing wall.

Built in the early 1900s, its kitchen had a large adjoining pantry that had a big window with a pleasant view. This room provided a great deal of storage space but it was terribly inconvenient. The homeowners were willing to sacrifice the storage space to get a comfortable eating area inside the kitchen and to enjoy the light and view from the window. So, we removed the wall. It only took two days for two people to tear out the old wall, install a new header and patch the plaster. Painting, wall papering and laying a new floor took longer, but they always do!

Look before you leap

The foregoing may sound a little too simple, and in some ways it is. It's true that any wall can be moved or removed. The real issue is how many problems you are willing to overcome,

and this usually means how much money you are willing to spend.



3 Begin prying the casing boards away from the wall using a wide chisel. Once a small gap is created, slide the tip of a flat pry bar behind the board and carefully push.



2 To save casing boards without damage, first see if the top board was toenailed into the sides. If so, drive these nails completely into the sides using a drift punch.

To decide this, you have to discover a couple of things. The first is what, if any, structural purpose is being served by the wall. The second is what, if any, mechanical systems (plumbing, heating, electrical) are running through the wall. Solving the structural problem is usually not too difficult. But rerouting plumbing, heating and electrical hardware is a different matter entirely.

To figure the wall's structural duties, you'll have to go exploring. This is best done by removing a 16-in.-square section of the ceiling next to the wall. It can be repaired later. Shine a flashlight into this access hole to see how the ceiling joists above the wall are posi-

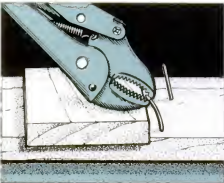
tioned (see drawing 1). If they are running parallel to the top plate of the wall, then the wall you want to remove is bearing no weight except its own. It can be removed without disturbing the structure of the house. If, however, the joists are running perpendicular to the wall, then you have a bearing wall and you must replace the support provided by the studs with a new header. (Note: Some walls are not bearing even when the joists run across them, especially if they are short walls that define closet spaces. But if you reach into the cavity above the top wall plate and feel the end of a joist falling on top of the wall, you are certain that it's load bearing.)

Once you've determined that you need to install a header, you have two options. The first is called a flush header. It is installed so its bottom edge aligns with the bottom of the ceiling. Your other option is a dropped header, the type shown here. Installing the former is a complicated and difficult task. So if you want the flat ceiling look, plan on hiring a contractor.

The latter is simply installed underneath the ceiling. It spans the entire opening and is supported on both ends with jack studs. This type functions in exactly the same way as the headers over the windows and doors in your home. In most cases, installing it is certainly within the capabilities of an active homeowner.

Hidden mechanicals

The best way to find out what is running through the wall is simply look at it. If you see light switches and receptacles, you know there's power in there. A heat register or cold air return indicates ductwork, and of course any



4 Do not remove the casing nails by driving them through the front of the board. Instead, pull them out from behind using locking pliers and a small wood block.

faucets or drains mean the presence of plumbing. If none of these is visible, you are still not in the clear, especially if you have a 2-story home. Each of these—or all three of them—could be passing through the wall, destined for upstairs rooms.

Of the three, the electrical changes are usually the least difficult. But the plumbing and heating changes can be a profound headache. One good way to see if they are in the wall is to remove the baseboard trim at the bottom of the wall, then cut out the drywall or plaster that falls behind it. (Note: Drawings 2, 3 and 4 show a few sensible tricks for removing high-quality trimwork. On this job, the casings shown were reused when a door was moved to an adjacent wall. The same techniques pertain to removing the baseboard. A little care taken at this stage can save a great deal of time and aggravation later.)

Now the stud cavities should be exposed. If you see copper tubing or cast-iron or plastic pipe, you've got plumb-

carried it out of the house and vacuumed the area clean. Be sure to wear gloves and a respirator to avoid contact with this dry and irritating substance.

Bracing the ceiling

In the past, we've always built two temporary walls to support the weight on either side of the wall that was to be removed. These consisted of a single top and bottom plate with studs nailed between so the assembly would just wedge upright between the ceiling and the floor. (A photo of this type of wall appeared in *How To Install New Windows*, page 112, Apr. '85.)

But on this job we came up with a different system. The basic idea is simple: We decided to build the header in place using the existing wall studs as temporary support. All that was required was turning the studs 90° so their faces were parallel—not perpendicular—to the surface of the wall. The studs still supported the weight above but occupied only 1½ in. of the wall thickness instead of the normal 3½ in. The remaining 2 in. allowed enough room to slide a single 2x10 in place as shown in drawing 9. Once this was in place, the studs were removed and the rest of the header installed as shown in drawings 11, 12 and 13.

Header thickness

The size of the lumber you need for a given header depends on the width of the opening you are creating and the weight you have to support. Because this opening was less than 10 ft. wide and the rooms above were just two typically furnished bedrooms, we used two 2x10s with a ½-in.-thick solid plywood spacer in between. If you have a



7 Where the wall abuts another wall, remove the end stud by driving it away from the bottom plate with a hammer. Then pull it away from the top plate nails.

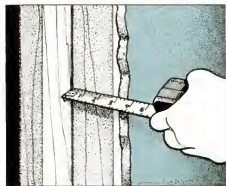
smaller opening, less than 8 ft. for example, two 2x8s with a ½-in. spacer should be plenty. A wider opening, up to 12 ft., requires two 2x12s with the plywood spacer. But if the weight



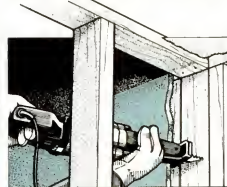
5 Once all the plaster or drywall is removed from the wall, pull out any visible nails using a nail puller. This simple tool is driven below the nailhead and pried back.

ing. If you see sheetmetal ductwork, you've got heating. If your answer to either is yes, then call in the appropriate contractor and get a written estimate of what the changes will cost. If there's nothing in the wall but sawdust and dead air, then you're ready to tear the wall out.

Of course, demolition is no fun. If the wall is covered with drywall, the job is tolerable. But if you have plaster and lath, your patience will be tested. Plaster dust is incredibly fine and has the uncanny ability to drift throughout your house. Because of this, seal off any doorways with polyethylene plastic until you've removed the plaster and lath,



6 Establish the overall size of your finished opening. Then measure back from this point to the next stud in the wall to make sure you have enough room for a jack stud.



8 If the adjoining wall was framed with a full length pocket stud, the top section of this stud can be cut off at header height and thus function as a built-in jack stud.

above is atypical—a bathroom or a room with a piano or other very heavy furnishings—consult your local building department to check the proper header dimensions for your situation.

Installation

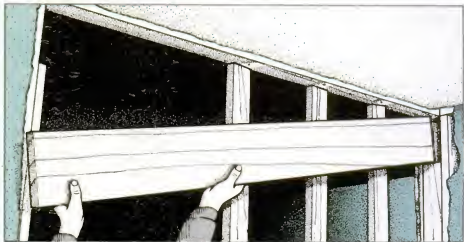
Once you have the studs turned in place, you must create support for the header on both ends of the opening. In a normal wall this is accomplished with jack or trimmer studs. These 2x4 members are cut to fit just underneath the header. They are then nailed alongside full studs and this assembly is nailed between the top and bottom wall plates. Once these are installed, the

header fits snugly between the two full studs and bears directly on top of two jack studs. Then it's nailed in place.

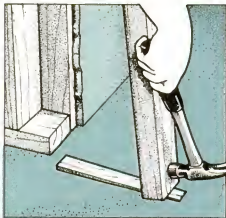
In this installation, one end of the header had to be supported in an exterior wall. By removing the last stud at that end of the wall we found a pocket stud, as shown in drawing 8, framed into the exterior wall. This is a very common situation. Because this pocket stud is nailed securely to two adjacent studs, all that was required for proper support was to cut off the top of the pocket stud to jack stud height using a reciprocating saw. Then the header simply rested on top of the pocket at that end. If you don't have a similar situation, build the jack stud and full stud assembly—mentioned earlier—for both ends of the header.

On the other end we wanted to bury our jack stud assembly in the part of the wall that wasn't being removed so we would have a square corner that would align with another partition. We cut the jack to size, nailed it to the full stud and then toenailed this assembly into the top and bottom wall plates.

Once these supports are properly installed, it's time to cut one half of the header to size and lift it into place. Measure the distance between the two full studs that are nailed to the jack studs and cut the 2x10s and plywood to the same length. Then sight down both 2x10s to determine which edge has a slightly convex arch, called a *crown*. Mark both with an arrow pointing at the crown so you will be sure to install both in the up position. (If the crown always points up, then once the weight is on the header, the header will tend to flatten out instead of bow down farther.) Then lift the first 2x10 onto one



9 Once a pocket is cut in one end and a jack stud installed in the other, pivot the remaining wall studs so their sides face out. Slide half of the header into place.



10 To pry the header into place, cut a stud $\frac{1}{2}$ in. longer than the header height, put it under the header and drive it with a hammer. A wood shingle protects the floor.

jack as shown in drawing 9.

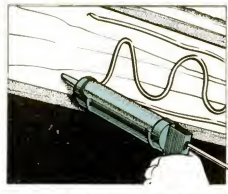
Depending on the amount of crown in the header and/or the amount of sag in the ceiling above, this board may be

difficult to slide onto the second jack. To pry it in place, use the stud and wood shingle method shown in drawing 10. Once the header is pried high enough, drive it onto the jack using a hammer. Then continue driving the header across the jacks until it hits the wall studs. At this point the studs can be removed and the half header will be strong enough to support the ceiling until the rest of the header is in place.

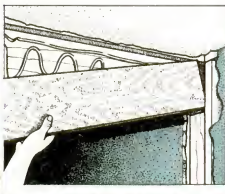
Continue to drive the half header across the jacks to occupy the space vacated by the studs. Do this gradually, moving each end a $\frac{1}{4}$ in. at a time. Do not strike the board with a sledgehammer because you run the risk of tipping it over.

Once it's in place, add the plywood spacer and second half of the header as shown. Then toenail the assembly into the framing members. Cover it and patch the walls and ceiling with drywall or plaster.

PM



11 Once the first half of the header is in place, remove the studs and drive it over into its final position. Apply construction adhesive to the side using a caulking gun.



12 Cut a piece of $\frac{1}{2}$ -in.-thick plywood to size and slide it into place next to the header. Nail the two together using 6d common nails driven every 4 in.-square.



13 Apply more adhesive to the side of the plywood, then slide the second half of the header into place. Nail this to the others using 16d nails in a 4-in.-square pattern.



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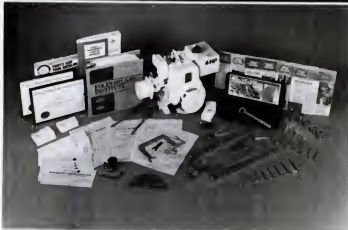
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MICROCARS

(Continued from page 96)



Three-cylinder Subaru Justy will offer 4-wheel drive and CVT as options for 1988.

Excel is basically a redone Mitsubishi Colt with a Colt-cloned 1.3- to 1.5-liter ohc engine. The Excel will initially be available in this country only as a 5-door hatchback, probably priced in the mid-\$5000 range.

Once American Hyundai comes up to speed in late '86 or early '87, the company will start bringing in the slightly larger Stellar or something like it. The Stellar is a rear-drive 4-door sedan



Spanish SEAT Ibiza is a fwd hatchback. Engine combines Fiat and Porsche parts.

derived from the European Ford Cortina, but with a 1.6-liter Mitsubishi-derived engine. In size, equipment, purpose and price, it rivals the Honda Accord, Toyota Camry and Nissan Stanza. The Canadian Stellar lists for \$9000 (U.S.) in standard trim and \$10,500 in GLS form.

Mitsubishi Motor Sales of America hopes to supply its U.S. dealers with something like 30,000 Hyundai Excels during 1987. These are in addition to those offered by American Hyundai dealers.

Spanish flyweight

The government-owned Spanish automaker SEAT (pronounced "say yacht") plans to bring one or more of its products into the U.S. in late 1988. Spain has the advantage among European carmakers of being able to offer inexpensive labor.

SEAT, through an agreement with Volkswagen, currently assembles VW Polos and Passats in addition to its own Giugiaro-designed Ibiza and Malaga models. By employing German VW quality control director George Heintz, SEAT now claims as good a fit and finish as its Wolfsburg peers.

Spanish buyers can't absorb all the cars SEAT can build, so the government is looking abroad for additional customers, first to Europe and then to North America. SEAT's sales organization in the United States may tap Audi dealers.

The model that SEAT proposes to bring over is currently in the hatching stage and has been code-named Majorca. The Majorca is a little bigger than Honda's CRX coupe and will arrive

with 1.5- and 1.8-liter Fours and front-wheel drive. (A 1-liter, 3-cylinder engine is also being contemplated for economy-minded Europeans.)

If these are like the engines in SEAT's current Ibiza and Malaga, the American Majorca powerplant is likely to be an ohc Four, set crosswise and tilted slightly forward, based on a Fiat block and lower end. The crossflow head and dished pistons, though, are engineered by Porsche, and the upper end of this engine looks very much like Porsche's 944.

SEAT's 1986 Ibiza and Malaga engines say "System Porsche" on the cam covers—in English!

SEAT's more distant plans call for a 2-seater sports model as well as sedans and 3/5-door liftbacks.

Will you go Yugo?

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VW Polo will be imported from Brazil as a 3-door wagon (shown) and sedan.

micro called the Yugo GV. Imported from the Zastava factory in Yugoslavia, where labor costs are only 60 cents to a dollar an hour, the Yugo's U.S. price is currently \$3990.

Two models are initially slated for U.S. introduction during 1986: the base Yugo GV (GV stands for "Great Value") and the sportier GVX, which reportedly will retail for \$4800. The

(Please turn to page 128)



Hyundai Stellar is a Korean Accord-class car that currently sells in Canada for \$9000.

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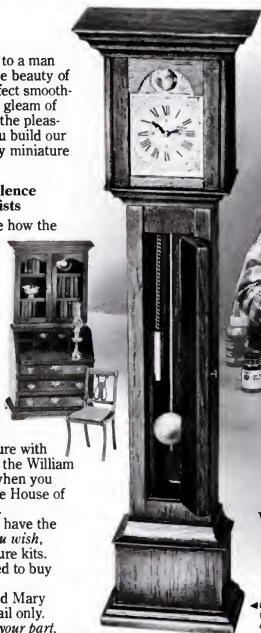
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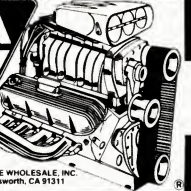
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MICROCARS

(Continued from page 124)

GVX's upgrades include exterior graphics, brighter upholstery, AM/FM stereo, alloy wheels, wider tires, black-out trim, fog lights and perhaps a larger, more powerful engine.

Yugo America hopes to sign up 277 dealers by mid-summer of 1986. Beyond that, company officials have mentioned bringing over a face-lifted version of the Yugo 55 for 1987. Then, for



Hyundai Excel is a 5-door fwd hatch made in Korea and expected to cost \$5500.

1988 there might be an Ital-Designed 5-door hatchback, with a 2-seater sports car—dubbed the Yugo TCX—due for 1990 or so. Whether the importer actually goes that far, though, depends on whether you go Yugo.

Skoda, too?

Not to be left out, the bizarre rear-engined Czechoslovakian Skoda Rapid, now sold in Canada for \$3600 (U.S.) is prepared to cross the border in 1988. Its 1.3-liter engine produces 62 hp and its swing-axle rear suspension quirky handling.

Greek Jeep

Another Third-World car that's serious about entering the U.S. is the Greek Desta APV (for "all-purpose vehicle"). The Desta plans to arrive this month in five configurations: van, pickup, wagon, convertible with hardtop and convertible with a ragtop. Prices will be in the \$5000 to \$6500 range.

All versions are built in Greece under license from Germany. The Desta uses



Greek mini-Jeep combines German engineering and Ford parts with fwd only.

front-wheel-drive mechanicals supplied by Ford of Europe. It has a 1.6-liter engine and 4-speed manual transaxle. It also boasts 4-wheel independent suspension, rack-and-pinion steering and front disc brakes.

The Desta's importer, Automotive Imports and Marketing of Phoenix, hopes to sell 20,000 vehicles here in the first year and wants to go nationwide within 18 months. Plans call for distribution of the Desta vehicles to begin on the East Coast.

Old teams, new players

In addition to the new names from the freshman importers, you'll be hearing a few more from the seniors as well.

Subaru will bring in a 1.2-liter Justy in 1987, available in 3- and 5-door hatch-



Ford Festiva, designed by Mazda [35-percent Ford-owned] will be built in Korea.

back configurations. The Justy uses a transverse, 3-cylinder ohc engine that, in Japan, delivers up to 63 hp from 1 liter. The U.S. car might have a 1.3 engine. Standard transaxle is a 5-speed. Subaru also hopes to offer an automatic, electrically controlled CVT (continuously variable transmission) and 4-wheel drive as options.

In addition, Nissan has cut a deal with Yue Loong Motor Co. of Taiwan to build the 1-liter Nissan March on Formosa and export it to the U.S. in 1988.

Ford has a similar deal with Taiwan's Lio Ho Motor Co., which will assemble a sporty version of the Mazda 323 called the Laser and sell it to Dearborn. Ford will also import Lasers from Mazda's Mexican factory.

Volkswagen has announced plans to import a new "entry-level" minisedan and 3-door wagon from Volkswagen do Brasil. VW builds several cars in Brazil, including the Beetle, but its U.S.-bound model is likely to be a version of the 1.1-liter fwd car called the Polo in Europe. Rumor of an upscale Ralph Lauren Polo signature model for preppies has already leaked out.

What this new wave of microcars will do is open up the lower end of the new-car market, in a price bracket now abandoned to used cars. Only time will tell which of these new cars will be jewels and which junk, but they're not all likely to stand the test of time. **PM**

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GRAND LUXE FOR BIG BUCKS

(Continued from page 94)

spoiler. The 190E 2.3-16 will top 140 mph and out-accelerate a new Corvette. It's the only 4-door sedan in the SCCA's new Super Sport racing class, where it will compete with stripped 2-seater Porsches, Ferraris and Vettes. Truly a remarkable family car.

Mercedes' mid-size sedans are all new this year. The styling is very similar to that of the smaller 190, and so is the chassis, with Mercedes' patented multilink rear suspension and ABS disc-brake system. As a package, this is probably the best all-around car Mercedes sells in the U.S.—reasonably sized, nicely appointed, with 125-mph performance. There are two engine choices: an all-new 3-liter, fuel-injected gas Six or an equally new 6-cylinder turbodiesel. The big 300 SDL has the same 3-liter, turbodiesel Six, while the identical 420 SEL has a 4.2-liter version of the 3.8-liter gas V8 used last year.

The 560 SEL sedan, 560 SEC coupe and 560 SL 2-seater are essentially unchanged from 1985, except that the V8 has been punched out to 5.6 liters. This is the largest, most powerful engine Mercedes has offered since the 6.9 of a decade ago. It's a clear indication of how times have changed from the fuel-pining years of the late '70s.

Within two years, Mercedes will replace the aged 560SL with a new 2-seater based on mechanicals from the more modern sedans. Prototypes of the new sports car look similar to the current 560 SEC coupe—bulbously aerodynamic but strikingly different.

BMW

In 1986, BMW becomes the first manufacturer to make antilock brake systems standard equipment across the line. The sporty 4-cylinder 318i has been dropped in favor of three variations of the 6-cylinder version. The plain 325 is the only BMW left for less than \$20,000. The 325es 2-door adds sporty seats, steering wheel and suspension. The 325e is a 4-door luxury version with leather upholstery.

All 3.5-liter models get an electronically controlled automatic transmission that smooths shifts by changing ignition timing as a shift occurs. The transmission has two settings: ECONOMY and SPORTY, with low- and high-rpm shift points, respectively.

Next year, we should see new 4-valve-per-cylinder heads on all BMWs. But the big news will be a 5-liter V12 engine made by grafting together a pair of 2.5-liter Sixes. This will be the largest BMW engine ever, and the first German V12 since the Grand Prix cars

of the '30s. It will be squeezed into the current 7-series sedan, and possibly into the 6-series coupe later on. Look for it to appear in a mid-engine endurance racer for Le Mans, too.

Mitsubishi

The economy Mirage and luxury Galant remain the same for 1986, while the neat little Tredia sedan and Cordia coupe get flush European-style headlights and wider tires and wheels. The Cordia Turbo now has bolt-on aerodynamic trim. The 1986 Starion sports coupe can be ordered with an intercooler for the turbocharged 2.6-liter Four, Porsche 944-style fender flares and 225/50-15 tires. Thus decked out, it's called the Starion ESI-R.

Audi

With the U.S. introduction of the 4-wheel-drive 5000S, every Audi model is now available with 4-wheel drive. Called the 5000CS Turbo Quattro, this car has a 158-hp engine, optional 5-speed manual gearbox and intimidating price tag. It's not exactly your run-of-the-mill boonie basher. The rest of the Audi line is the same as 1985.

Isuzu

The front-wheel-drive I-Mark—also sold by Chevrolet dealers as the Spectrum—was new midway through last year. It's a 1.5-liter econobox styled much like the previous Mazda GLC, and provides pleasant—if basic—transportation. Isuzu's other model is the lovely Giugiaro-styled Impulse. Top of the line is the 140-hp Impulse Turbo, introduced in mid-'85. It's one of the nicest sporty coupes on the market.

Saab

There are two new Saab models. The long-awaited 9000—5-door luxury hatchback that's the first all-new Saab in two decades—is aimed right at the Volvo 760 GLE, Audi 5000S and Mercedes 190E 2.3 buyer. The 9000 uses the same 2-liter turbocharged engine as the 900 Turbo, but fitted transversely across the chassis rather than longitudinally. The styling is innocuously aerodynamic. In the spring, Saab will unveil a convertible 900 Turbo. This will also cost well over \$20,000 and, of all things, bear a striking resemblance to the fondly remembered Porsche 356 Speedster of the '50s.

Porsche

The 924 will soon be brought back as an under-\$20,000 "cheap Porsche." The U.S. version will use the familiar 2.5-liter

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Four from the 944, *not* the Audi-based engine of the original 924. The 944 remains the same, which is just fine because it's one of the best-balanced sports cars on the market.

The newly introduced 944 Turbo is priced at \$29,500 for a special stripped model for Showroom Stock racing. The one you'd want will cost \$34,000 or so. If you can afford the tab, go for it. The 944 Turbo is sure to be one of the Great Cars—well balanced, fun and wickedly fast. Porsche will no doubt be in the happy position of having year-long waiting lines for the 944 Turbo. It's worth the wait.

For 1986, the 911 Carrera is joined by a 911 Turbo. This is derived from the 930 Turbo, which was sold in this country 10 years ago, and was one of the fastest road cars ever made available to the public. Like the 944 Turbo, the 911 Turbo will have Porsche fans lining up eager to pay \$50,000 for the dream of a lifetime. The top-line 928S remains the same as in 1985.

Peugeot

The Peugeot 505 Turbo now has 150 hp thanks to a new watercooled turbocharger that's both more powerful and more reliable. The turbo is available in the station wagon for the first time. All Turbo models come with a front air dam and driving lights as standard equipment, while all Peugeots have a new ergonomic interior designed by Swiss industrial designer Paul Bracq.

Jaguar

The oft-promised XJ40—a more aerodynamic, more fuel-efficient replacement for the current XJ6 sedan—won't see production until next year, if then. But the XJS Cabriolet, a convertible version of the current XJS, will come to the Colonies in 1987. It will have the tried-and-true V12 under the hood, *not* the 3.6-liter Six originally promised—which is fine by us.

Alfa Romeo

Alfa has an all-new model, called Milano. The Milano is a 4-door sedan built on the same chassis as the current GTV6 coupe. This means a 2.5-liter V6, 5-speed and rear-drive. The Milano resembles the new Saab 9000 in appearance and performance, but costs substantially less. Next year, look for a twin-turbocharged version.

The venerable Alfa Spider Veloce was dressed down last year to create the inexpensive Graduate; it's been dressed up this year to make the pricey Quadrifoglio. *Quadrifoglio* means four-leaf clover in Italian and is the symbol of the old Alfa racing team. The car is bedecked with fiberglass spoilers, spats and air dams, plus a fiberglass hardtop. The interior is all new, and

there are modern alloy wheels. Underneath lives the same old Spider Veloce. Price tag: \$20,000.

Yugo

Malcolm Bricklin, the man who brought us the Subaru 360, Bricklin GT, Pinnafarina Spider and Bertone X1/9, now peddles the cheapest new car you can buy. Designed in the late '60s around Fiat 128 parts, the Yugo is a tiny econobox built under license by Zavodi Crvena Zastava of Kragujevac, Yugoslavia. Bricklin has priced it at \$390, making it the cheapest new car available in America right now (see *Cheap Wheels*, page 93, Dec. '85).

Maserati

Alejandro DeTomaso is on a roll. His old friend Lee Iacocca has him working on a new Chrysler-Maserati 2-seater, while the Maserati Biturbo has taken its place as the Beverly Hills exoticar of the year. Who would ever have dreamed Maseratis would sell by the thousands, rather than the dozens? Two new models include a Cabriolet convertible and a 4-door version of the Biturbo coupe. The pricey Quattroporte sedan remains the same as ever: nearly invisible.

Rolls-Royce

Rolls-Royce celebrated building its 100,000th car last August. The company began building cars 82 years ago. By comparison, General Motors sells that many cars in a week. But Rolls-Royce is doing just fine, thank you. Production is back-ordered six months, and the only changes are positive ones.

There is now a limousine version of the Silver Spur. At \$198,000, it's the most expensive production automobile in the history of the world. Coming along is the Bentley Project 1990, a sleek fastback coupe reminiscent of the fabulous Bentley Continental of the early '50s. If this one is as good as its ancestor, it'll be very good, indeed.

What did Rolls-Royce do to celebrate its 100,000th car? It took each employee for a ride in a Rolls-Royce—three at a time—and gave them tea. For most of the blokes, it was the first time they'd ever been inside one of their own products. There will always be an England!

It remains to be seen how the deportation of R-R's best U.S. customer—the guru Bhagwan Shree Rajneesh, owner of 82 Rollers—will affect the company financially. There could be a glut on the used Rolls market if the swami's followers thin out the fleet.

Bertone

First sold as a Fiat in 1973, the Bertone X1/9 has ended an unhappy relationship with Malcolm Bricklin and

(Please turn to page 144)

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GRAND LUXE

(Continued from page 133)

is now being imported by a number of former distributors. The nimble mid-engined car is showing its age, and is scheduled to be replaced by a more powerful, "affordable" front-engined car, but not until 1987 or '88. Meanwhile, the handsome but noisy little wedge is unchanged for '86.

Ferrari

For just \$87,000 you can buy the last word in exotic 2-seaters. That's the 180-mph Testarossa, successor to the 512 Boxer. The V12 Testarossa is not only the fastest production car you can buy, but strikingly styled, elaborately finished and sure to be a collector's item from Day One.

The 308 line has been mildly restyled and the 3-liter V8 bumped up to 3.2 liters and 270 hp. They're now called 328 GTB and GTS.

Lotus

Lotus continues to stagger along, offering just one model, the Esprit Turbo. It's a \$50,000, 150-mph 2-seater sold in such limited quantities that you're almost guaranteed never to see one. That's exclusivity.

Lamborghini

Lamborghini has lost its crown to Ferrari. The new Testarossa is demonstrably faster than the Countach, and \$20,000 cheaper. Lamborghini is responding by restyling the Countach for better aerodynamics and consequently a higher top speed. Can the first 200-mph production car be far away?

Pantera

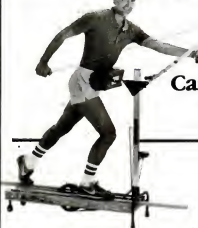
The DeTomaso Pantera, first developed for Ford in 1971 when Lee Iacocca worked for Henry II, is still being made in Europe. Australian-built Ford 351 V8s are installed in Italy. The completed cars are imported and modified to meet U.S. specs by Stauffer Classics Ltd. in Blue Mound, Wisconsin. A huge air dam, wheel flairs and a Countach-like rear wing are the latest additions to the mid-engined GTs.

Where do we go from here?

The Japanese carmakers are talking seriously about having to abandon the small-car market to the Koreans during the next decade and moving up into the \$15,000 to 25,000 market. There, they would be fierce competitors not only with American carmakers, but Europeans as well. If that's the market you're in, you can expect some exciting times and interesting cars in the years to come.

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NordicTrack's stand-up skiing motion more uni-

HANDSAWS

(Continued from page 112)

cuts. A heavy steel spine is added to the blade to provide stiffness that makes it easier to cut with precision. Two brass screws secure the hardwood handle to the blade. The backsaw is available at hardware stores and home centers for about \$17.65. Contact Sandvik Tools, Box 1220, Scranton, PA 18501.

15. Keyhole saw—Unlike its Western counterpart, this Japanese keyhole saw has a shorter, narrower blade that cuts on the pull stroke. The 15½-in.-long saw has an 8-in.-long blade with 12 tpi. Use this agile saw for cutting small keyholes, curves and slots. The Japanese keyhole saw is available for \$6.95 postpaid from Fine Tool Shops, 20 Backus Ave., Danbury, CT 06810.

16. Blitz saw—This versatile German-made saw comes with three interchangeable blades for cutting wood, metal and plastics. Use the blitz saw for delicate slotting and to cut small dovetails. A curved tip on the saw frame's end serves as a second handle. This permits 2-hand operation during super-duplicate work. The 5-in.-long steel blades have a ¼-in. depth of cut and are secured to the saw with a single wingnut to make blade changes quick and easy. The blitz saw, with three blades, is available for \$7.90 postpaid from Constantine's, 2050 Eastchester Rd., Bronx, NY 10461.

18. High-tension hacksaw—To cut metal quicker and smoother, try this high-tension hacksaw. It features a cranking handle and a tension indicator that allows you to apply just the right amount of tension on the saw blade. The proper amount of tension will prevent the blade from flexing during the cut, which will, in turn, make the blade last longer and cut easier. The blade can be installed at a 90° position or at a 45° angle for flush-cutting. The saw's comfortable, closed, die-cast aluminum handle provides excellent knuckle protection. The saw accepts 12-in.-long hacksaw blades. The high-tension hacksaw comes with one bimetal blade for \$19.90 postpaid. For more information contact US General, 100 Commercial St., Plainville, NY 11803.

19. Nest of saws—Here's a valuable tool for the active homeowner. The Stanley nest of saws is actually four saws in one. This versatile tool comes with three interchangeable blades (one blade has two cutting edges) to handle many cutting jobs around the home and yard. The hardwood pistol-grip handle is shown holding a 16-in.-long, double-edged blade that has fast-cutting pruning teeth on one edge opposite a crosscut edge with 7 tpi.

The saw also comes with a 14-in.-long compass blade (7 tpi) and a square-ended, 10-in.-long finishing blade (9 tpi). The steel blades are held securely to the handle with

(Please turn to page 136)

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HANDSAWS

(Continued from page 145)

a quick-change wingnut and bolt. The nest of saws is available for about \$13.65 at hardware stores and home centers. Contact Stanley Tools, Myrtle St., New Britain, CT 06050.

20. All-angle saw—Have you ever had difficulty cutting a workpiece because it was in an awkward position? The all-angle saw was designed to tackle such frustrating cutting chores. The saw features an adjustable handle that can be secured anywhere along the tool's bow, or frame. This permits you to lock the handle at the most convenient working position. The saw accepts a 6-in.-long blade and it comes with one woodworking blade (14 tpi) and one metal-cutting blade (32 tpi). It's available for about \$7 at hardware stores and home centers. For more details, contact Disston, 1030 West Market St., Greensboro, NC 27401.

21. Pocket saw—Stanley's new folding pocket saw accepts standard saber saw blades and reciprocating saw blades to handle a wide variety of cutting jobs. The saw folds like a jackknife to conceal the cutting edge. The 8-in.-long plastic handle has a spare-blade storage compartment and a positive blade lock that secures the saw in the open position. The saw comes with one all-purpose blade (10 tpi). The pocket saw costs about \$7.85 at hardware stores and home centers. Contact Stanley Tools, 600 Myrtle St., New Britain, CT 06050.

22. Brick saw—You may not have to saw bricks very often, but when you do, this is the saw to use. This specialized tool is designed to cut magnesite bricks and most furnace-lining insulating bricks. The 15-in.-long, coarse-cutting blade cuts on both the push and the pull stroke. It's sold at hardware stores for about \$11.69. For details, contact Disston, 1030 West Market St., Greensboro, NC 27401.

23. Dozuki saw—The dozuki saw is the Japanese equivalent to the Western backsaw. The model shown features a 9 1/4-in.-long, replaceable blade. It has a steel back support that adds rigidity to the blade. The 13 tpi, pull-cut stroke blade fits into a 10 1/4-in.-long bamboo-wrapped wood handle. Use the dozuki to cut tenons and precise joints. The dozuki saw is available for \$17.95 postpaid from Woodcraft, 41 Atlantic Ave., Box 400, Woburn, MA 01888.

24. Japanese dovetail saw—Like the dozuki saw (see No. 23), this Japanese saw features a replaceable blade. But, the dovetail saw has a shorter, stiffer blade to provide greater control when cutting dovetails and other tight-fitting joints. The very fine-cutting, 7-in.-long blade has 25 tpi. Maximum depth of cut is 1 1/4 in. The saw costs \$27.10 postpaid from Garrett Wade, 161 Ave. of the Americas, New York, NY 10013.

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THE WRITE STUFF

(Continued from page 116)

on a simple jig, as shown in the drawing. Nail a 3/4-in.-dia. dowel to a piece of wood. Measure down 2 in. from the top of the dowel and draw a horizontal line. Next, place the bottom of the U on this line and tape it in place. Then, grip the assembly in the vise and make the 180° bend for the tops of the U.

Cut the calendar base on a table saw, making it several inches oversize. This will provide a perimeter area for nailing router guide strips in place. Locate the recess for the formed rod and trace its outline on the base.

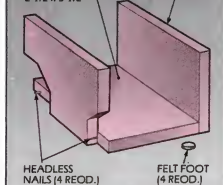
Also trace the outline for the brass mending plate. Tack two strips of wood in place for the router guides, repositioning these guides as necessary to cut the recesses. Use a 3/32-in.-dia. straight router bit.

The brass mending plate serves as a spring, bearing against the portion of the rod you have filed flat. This keeps the rod in tension with its ends in the holes. Glue and clamp a 1 x 1-in. backup block to the bottom of the base to provide meat for the screw that secures the mending plate.

Cut the beveled back and front bottom strips, and the angled runners. Secure them with glue, and clamp in place until dry.

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Finishing the pieces

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You will need some capital, but it will grow as you grow. And you will need a vehicle, preferably a pickup. Then it comes back to the four factors of personal success mentioned above...and you.

CORVETTE ROADSTER

(Continued from page 74)

other soft-top car I've ever driven. The roadster steers beautifully, too, and there's no cowl shake at all.

With the top down, the Corvette roadster looks like the coupe minus the fastback roof. The new top and even its mechanism are straight from 1968-'75 Corvette convertibles; nearly identical in the way it works. Major changes include the use of aluminum bows and a solenoid release for the deck and top latches. That is, the fiberglass deck lifts up, you raise the top manually and then latch the header with two handles. Finally, you put the deck back down and, with the heel of your hand, shove two pins at the rear into latches in the boot. The top fits tight and snug. It's lined on the inside and has trim flaps that stick onto the roof bows behind the windows with Velcro fasteners.

The roadster uses Corvette's port-injected 350 V8, but with aluminum heads. The heads save 40 pounds and compensate for the added weight of the roadster's uniframe. As it turns out, the coupe and roadster are within 30 pounds of each other. Corvette chief engineer David R. McLellan said coupes will also get aluminum heads during 1986.

The Doug Nash manual transmission, based on the old Warner T-10 but with a hang-on 2-speed overdrive, takes some getting used to, especially downshifting with a combination of the stick-mounted overdrive button and the shifter itself. It's sometimes hard to judge which of the lower six ratios to shift down into. But after covering 271 miles in California's Yosemite National Park, I had the thing knocked and found the 7-speed much more fun to drive than the automatic.

The automatic goes awfully well, too. What's so amazing about both gearboxes is that, in high overdrive, the engine barely ticks over at 60 mph—something like 1700 rpm (depending on rear-axle choice: there are three ratios).

Antilock brakes

I tried the Corvette's antilock braking system (ABS) and, sure enough, the wheels don't lock. The system, by the way, uses German Bosch hardware, U.S. Delco software and the Vette's Australian Girlock 4-wheel discs.

You've probably heard by now that the 1986 Corvette roadster will pace this year's Indy 500. That means the entire production run of 6000 or so '86 roadsters will all be pace-car replicas, which makes them eminently collectible, same as the 1978 Corvette pace cars. So if you want one, better hurry. Even at a projected base price of \$32,000, they're going fast!

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WORKING IN SPACE

(Continued from page 105)

back off the nut after breaking it free with the handle. The Space Telescope has been designed so that this one tool—Detroit take notice—equipped with a 7/8-inch-deep socket and various extensions, can handle all maintenance, module replacement and fixes for failures expected during the 15-year life of the spacecraft.

If either of the Space Telescope solar panels doesn't unfold, an astronaut will have to crank it open with 130 turns of the wrench. Such repetitive motions tire an astronaut fast. Therefore an exotic space-age Power Ratchet Tool has been developed by Inland Motor under the guidance of NASA Goddard Space Center. The astronaut can set the tool to rotate in either direction, and can select one of eight different torques or eight different numbers of turns stored in memory. Through an RS 232C serial port, the settings can be reprogrammed.

If desirable on big jobs, the tool could be connected to a Shuttle computer by cable or wireless link. The astronaut would only have to place the socket on a fastener head and pull the trigger. The computer would look up the fastener and set the tool for the right torque or turns. Peculiarly, there is no setting for 130 turns. Memory limits the top number of turns to 54. To open the solar arrays, the astronaut must select the top—continuous turns—setting.

Space tool motorization

Drawing on its experience building actuators for target drones and the T27 rudder, Inland Motor used a DC brushless, inside-out motor. Samarium-cobalt magnets mount on the shaft. Windings go on the outside, where they are easier to cool. A microprocessor controls solid-state switching to the windings to replace the function of the brushes. This kind of motor is preferred in space, because brushes wear out fast in a vacuum, probably from overheating. In a vacuum, radiation is the only way to cool. A fan on one end of the motor shaft would be useless.

Nevertheless, to gain the advantages of taking a tool off the shelf, NASA accepted brushes in its EVA Power Tool. Born as a \$159 AEG heavy-duty cordless electrician's drill, the tool was turned over to ILC Space Systems for conversion to space use. It runs forward and reverse at two speeds and has a clutch that can be set to release at four different torque settings. Rechargeable nicads in the handle drive the 7.2-volt motor. ILC replaced the chuck with a 3/8-inch drive, and changed the reduction gear to lower the speed. It covered the glass-filled Lexan plastic

housing with aluminized tape to shield it from flames and to keep volatiles from evaporating and redepositing on cold windows, mirrors or lenses.

The motor had to be vacuumized. All lubricants were removed and replaced with dry film or fluorinated lubricants that won't evaporate as easily. Impregnating the brushes with a fluorinated oil cut down the rapid wear. The tool has seen duty on several flights. On the first day of the Leasat repair, astronaut Fisher bolted an electronic jumper box in place with the tool and fitted it with torque-set bits—a variation on the Phillips head—to remove screws. Though carrying a 6-inch trash bag, Fisher dropped several screws, which were later joined by the tool itself in the Leasat constellation.

Every bit helps

To keep from losing the tool's bits, Bruce McCandless devised a system nicknamed the MacTether that requires an astronaut to insert a tether into a bit in order to release it from its caddy. After the bit has been placed on the tool, removing the tether locks the bit in place. Losing a tool or screw inside the Shuttle is no problem for the astronauts. They just have to look in the ventilation intakes.

Two smaller cordless power screwdrivers from AEG and Skil have undergone test but have not been flight qualified. The biggest power tool, called the Module Servicing Tool, took part in the rescue of Solar Max, a standardized spacecraft which plugs in different modules for varying missions. The tool, which looks like a stubby 50-caliber machine gun, helps change a module by clamping onto it and backing out a jackscrew that pulls it loose from all its connectors. Reversing the procedure installs a replacement.

As engineers look ahead to space stations that will stay in orbit for decades, they see a much greater need for repair. They are looking at more exotic tools and many more battery-powered tools to reduce work time, effort and fatigue. Some power tools, such as welders, will have to draw on space-station power. Weight-saving composites will make up a greater proportion of the space station than of today's spacecraft. Means will have to be found to form, bond and cure prepared composite patches. Planners are thinking about including a repair shop aboard the station and building a more elaborate work station than the present one for the end of a manipulator arm.

One power tool that deserves deep thought is a street sweeper. Debris from construction, repair, launches and visits from supply ships could soon make the station look like a moth-surrounded porch light.

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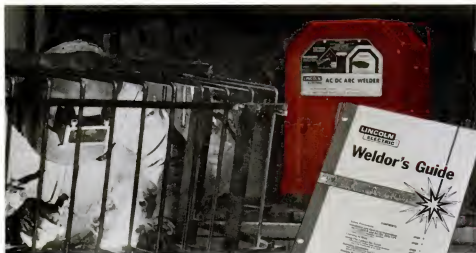
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COLOSSAL COMPUTERS

(Continued from page 108)

residents of the beleaguered community thought they had wandered into the Twilight Zone.

■ Recently, the Lotus Development Corp. revealed that its widely used Symphony 1.1 software program had a serious flaw that could cause users to lose large amounts of data. Lotus Development spokesman Ron Scott said the company was "not certain how the glitch slipped in, but the important thing was to get the glitch-destroying disk to its customers."

Lotus became aware of the Sympho-ny problem after users—primarily managers of large corporations—complained that some data disappeared when they performed common tasks on the program's spreadsheet, a type of electronic ledger.

Computer coup specter

One must wonder, with so many possibilities of hitches in computer operations, is a Forbin-like nightmare possible? On this issue, computer professionals stand divided on both sides of the fence.

This year, the world's fastest and most sophisticated computer, the Cray-2, was installed at NASA's Ames Research Center. The Cray-2 is the first building block in the creation of NASA's new supersystem, a combination of large, advanced components, to be used in aircraft design, flight research, chemistry, weather prediction and genetic engineering.

Cray hardware, with its pluggable modules and supercooled elements, may also be called upon to operate the Strategic Defense Initiative, called Star Wars. Both systems need supercomputers to run them. Both have potential "runaway computer" problems.

Forbin's Colossus was also called upon to operate American defense systems. Possibly, someone at the Defense Department saw the Forbin project film early because, last year, a spokesman said the department would try to keep Soviet-bloc students and scholars from virtually all the supercomputers and supercomputing consortiums in the United States.

Others among the academic community see the threat of runaway computer glitches and inadequacies as a more vital problem than thwarting Soviet access to American technology.

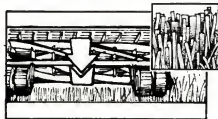
"Bugs in the systems—hardware or software—are always possible," says Carl Schmidt, professor of psychology at Rutgers. "You never know what form they will take."

Schmidt says software bugs could range from the general garden variety of lost information to serious errors in

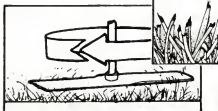
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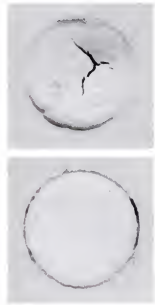
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the programs. These, he says, could cause anything from down time to a "totally unexpected" occurrence. "I personally wouldn't want to say what would happen if our defense system relied upon a supercomputer," says Schmidt.

Steve Braun, a spokesman for the University of Rochester's Artificial Intelligence Consortium (a funded group of eight universities) offered this insight, "The concerns here are not whether the computer will run wild, but how to test the program that will run the Strategic Defense Initiative.

"The only way we will know how the system will perform is to test it under actual battle conditions. No amount of simulation will substitute for actual use of the program and hardware."

Perhaps the final word comes from Zellman Warhaft, professor of mechanical and aerospace engineering at Cornell University:

"Knowing what computers do and how they act, it would be suicidal to assume that they could be used to operate our defenses. First, the program to run such a system would consist of a minimum of 10 million error-free lines. For a human being to write such a program is, of course, unlikely. The amount of hardware on the ground and the amount of hardware that would have to be orbited is stupendous."

What computer could control 1600 laser stations to monitor and destroy all of the ICBMs that would be launched in an actual nuclear attack? Warhaft says there is no such computer. He echoes colleagues who say the system can be tested only "under battle conditions."

"If the computer ran the system at 99 percent efficiency. That single 1 percent of error would result in the equivalent of 700 Hiroshimas," Warhaft says. "We would have a holocaust of global proportions. Cities such as New York would be wiped off the face of the Earth."

"I'm sure you've watched Shuttle launches. How many times has the Shuttle reached the point of lift-off when a

computer error shuts down the system? This is the same type of machine that would run the SDI.

"I personally would not dismiss any scenario—even one as fictional as that depicted in the movie ('Forbin')—there is no way to tell," Warhaft says. "It is as simple as that."

Tokyo University computer scientist Yoshio Akama told a gathering at Japan's recent Expo '85 that the threat of a runaway computer "is very real, but it is not something we cannot defend ourselves against."

Akama says that two Japanese supercomputers currently being used in high-energy physics experiments are designed with fail-safe systems similar to the design of the parallel computer software itself. The parallel computer works by having three or more small computers calculate parts of a problem at once, dumping their answers in a billionth of a second onto a central processor. That is one of the methods of making simple computers into fast-thinking supercomputers. To prevent runaway computing, a secondary system is set up simply to monitor the flow of information from computer to computer in the main system. If any of the individual computers send out information that they aren't supposed to send, the secondary system shuts down the main system. A diagnosis is then performed. The entire process takes less than 10 seconds, from discovery of a glitch to resetting the system back to normal, to restarting it. If the system can't be reset back to normal, human programmers are notified and must do the repair work.

"We have created the computer mind," Akama notes. "We are the gods over these intelligences. We have the power to make them greater. We have the power to bring them to a halt."

With that sort of hope in mind, the Defense Department, NASA and other users of supercomputers are moving ahead with development of ever-increasing machine intelligence.

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TO ALASKA AND BACK

(Continued from page 102)

a Mazda RX-7. The event's only mishap? One thoroughly crunched Saab.

Twelve months later for the 1985 edition, 27 vehicles sallied forth from Bellevue, Washington, just north of Seattle, for the first 2500-mile leg to Anchorage (like going all the way from Montreal to Venezuela that that flying crow). PM intercepted the Alcan in Anchorage and rode to the finish in Courtenay, Vancouver Island, just north of Victoria.

The opening salvo

The first half was broken up into four legs of 541 miles (from Bellevue to Quesnel, B.C.), 621 miles (from Quesnel to Fort Nelson, B.C.), 993 miles (from Fort Nelson to Dawson City, Yukon Territory), and 504 miles (Dawson City to Anchorage).

Ralliers competed on Hines's time/speed/distance sections—most using sophisticated TerraTrip computers to keep a split-second tab on the odometer—and then bombed along the dusty tote roads leading north to pre-arranged overnight stops, with an optional nonsoaring dash to the Arctic circle and back, a little sidetrip covering almost 550 miles.

This extracurricular exercise was not without a bit of unexpected excitement. Paterson, last year's winner, drove his Mazda off the snow- and mud-slacked highway, ditching the vehicle on its side in the tundra. Doug Kopp and Charlie Martin, in the 4-wheel-drive Rolls, gambled to the rescue with a set of bag jacks and righted the hapless Mazda to drive again. Throughout the Alcan's early stages, wherever the Rolls 4x4 stopped, the pair would be surrounded by gawkers, and Kopp would patiently recite the Rolls' hybrid lineage: "She's a '69 Rolls-Royce Silver Shadow with a 500-cu.-in. Caddy engine. The Jeep chassis with transfer case was fastened to the Rolls' unibody and she's got a Ford pickup rear end."

Kopp and Martin spent months preparing this rather eccentric piece of machinery. Other ralliers spent equal care, if not equal time, getting their own cars ready for the Alcan. Rows of high-intensity Marchal driving lights were standard equipment on most vehicles, and proved their worth on the murky, moonless nights. Fanatics fitted wire rock-stoppers to their grillwork or around their headlights. True initiates bolted padded crash cages into their interiors and festooned their exteriors with decals. Spare parts usually included an assortment of belts, a pair of tires, brake pads, filters and various fluids. The human element maintained its competitive edge with

coffee, apples and granola bars. The planning paid off as the Alcan headed north.

Blown tires, depleted fuel reserves, rocks jamming in engine parts and close encounters with mother nature were the norm throughout this madcap jaunt to the 49th state, including a harrowing passage over snow and ice on the Top of the World Highway from Dawson City to Anchorage. The narrow road and frequent 4000-foot drop-offs served as nature's No Doz. As rallier John Fosse observed, "If you drop off the edge, you'll starve to death before you hit bottom."

Reigning national pro rally and One Lap of America champ John Buffum, driving the spanking new Audi 5000 Quattro with ace navigators Tom Grimshaw and Paul Choinierie, led the rally at Anchorage with a low-point score of 27. To the almost universal astonishment of ralliers and local press, New Jersey's Al Schmit and co-driver Bill Todd remained a scant two points out of first in their '73 Bug.

"You just can't make any mistakes," Schmit, a passenger service representative for Pan American Airways, explained following the 2-day Anchorage layover. "One tiny error in navigation, car preparation or driving and you're completely sunk."

Indeed, consistency rewarded the competitors in the top four at the halfway mark: Only eight seconds separated Buffum, Schmit, brothers Lee and Rod Sorenson of Sacramento, California, in their beautifully prepared Mazda RX-7, and Gene Henderson and Mike Van Loo of Pinckney, Michigan, in a new Subaru XT coupe.

The Kopp/Martin amalgamation rolled into the Anchorage halfway point in seventh place, respectable by the world and national standards taking shape in the upper ranks.

Derring-do on the Denali

Schmit's observations turned prophetic on the return leg out of Anchorage, a 1200-mile all-night, all-day run to Watson Lake, Yukon Territory (the same distance a crow might cover from, say, Berlin to Madrid).

As the fleet rumbled east along the Denali Highway heading for the Yukon border, Schmit blew an oil line and John Buffum captured the Class A award for his efforts in getting the little bug going again—scurrying around in his T-shirt in the bitter chill, up to his elbows in Valvoline. Continuing oil-line problems and a cracked belt pulley on their retrofitted 2-liter powerplant eventually lowered the Schmit/Todd entry to an ignominious DNF.

Buffum's exploit on the Denali Highway was only one sample of the kind of anecdotes ralliers would collect en

route, embellish to taste and pass along. Consider the Denali Highway itself: cold, forbidding, surrounded by jagged snow-swept peaks. A mere 24 hours after the rally passed through, a snow squall hit, rendering it impassable 'til spring.

And what about rallier Ken Maytag's appeal to the heavens for new brakes? When the Carpenteria, California, native rolled into Dawson City, and very nearly rolled right back out, he remembered what his mother always told him. When you're in trouble, contact the nearest Episcopalian minister. Maytag found the Deacon of Dawson City's St. Paul's Anglican Church, who intervened with a Royal Canadian Mounted Police mechanic named Ernie, who in turn fixed Maytag's brakes. It pays to have connections.

Missed it by that much

Shortly after we left Buffum and Schmit puzzling out the VW's oil hemorrhage, POPULAR MECHANICS' faithful correspondent had a brush with catastrophe. There I was, riding through the Alaskan night in the back seat of the Rolls while Charlie Martin and Doug Kopp articulated their joint philosophy of life. Charlie was nearing a verbal crescendo when a she-moose bounded out of the left-hand ditch to cross the road, a single glowing eyeball towering over four massive legs. Charlie did his best to avoid a collision, but the Rolls clipped the creature in the kneecaps. Happily, she escaped into the forest without serious injury. Somehow, every segment of the Alcan 5000 produced its share of near misses.

After a well-earned overnight rest at Watson Lake, the Alcan 5000 moved south along the Cassiar Highway through British Columbia. We wound up in Prince Rupert after this all-day 599-mile run, and boarded the ferry for the 19-hour trip to Vancouver Island via the Inside Passage.

With Schmit out of the running, Buffum clung to first place if you counted the option granted each entry to throw out their worst score. (Buffum's throwout came early in the second half, when he was faced with the choice of picking up a 15 point penalty on his regularity or running into a school bus.) The slightest mistake on the 197-mile timed section down the spine of Vancouver Island could plunge the champ down in the standings and would elevate the incredibly consistent Sorenson brothers in their RX-7 and the Henderson/Van Loo team in their factory Subaru. Schmit's involuntary departure also breathed life into the Czechoslovakian Skoda driven by native Vancouver Islanders Derek Steel and Blake McGuffie. Rumbling sedately along in fifth place just 14 points back were

Kopp and Martin in the Rolls. As the indefatigable Martin put it when the ferry stopped in Port Hardy, "We're knocking on Skoda's door."

The Skoda was slightly more consistent than the Rolls on home turf, though, and the Steele/McGuffie team maintained its 12-point edge over Martin and Kopp. Strong showings by the Sorenson and Henderson teams couldn't unseat Buffum, and the champion rallier added the Alcan 5000 to an already impressive win list.

How did Buffum do it? PM had a chance to ride with the Buffum/Grimshaw/Choinierie team during one section between Whitehorse and Watson Lake. There's no questioning Buffum's knack for wrapping automobiles neatly around the curves, assisted no doubt by the Quattro's road-handling qualities. But there was a lot of teamwork in the winning vehicle. Tom Grimshaw would predetermine the time the Audi should hit precise points on the course, foregoing the more sophisticated TerraTrip computer for a simple LED odometer and split timer. Armed with the knowledge of precisely when the car should be at specified points, Tom would inform John every tenth of a mile how many seconds he was ahead of, or behind, the average speed. Paul Choinierie would keep an eye on directions in the route book prepared by the rallymaster and make sure the Quattro remained on course. Paul would also spot control vehicles (occupied by rallyworkers who did the scoring) and note the exact time and mileage they were observed so the team could double-check the rallyworkers' final tally.

"The key," according to Grimshaw, "was matching our mileage to the mileage in the course book down to the hundredth of a mile. Nailing that down was the whole ball game."

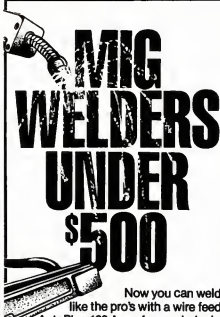
Ready for the next one

The rest of the Alcan ralliers will have a chance for a rematch in the fall. Hines reports that preparations for the '86 Alcan 5000 are well under way and the event will be staged Sept. 20 to 30. Hines plans on running the initial legs up Vancouver Island, with a reverse trip up the Inside Passage on a British Columbia ferry to Prince Rupert before proceeding to Alaska. To provide the kind of flair the Alcan is fast becoming known for, the finish line tape will be at Canada's '86 Expo in Vancouver, British Columbia.

"It'll be just as tough as it's always been," Hines says, "providing adventure and a proving ground for drivers, navigators and automobiles."

It's already bigger. From now on, it looks like the Alcan 5000 is just going to get better. Tell that crow to pack his bags.

PM



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TRAVELING LIGHT

(Continued from page 99)

pounds (18 pounds with built-in 40 character-per-second thermal printer) and offering a bright, high-contrast, high-resolution display (640 x 400 pixels or dots) thanks to its 2-inch-thick gas plasma (GP) screen.

Though some viewers might quarrel with its neon orange-on-orange look, the display is razor sharp and easily viewable from any angle—a quantum leap beyond today's LCD screens. Unfortunately, there's a trade-off. The power-hungry GP screen precludes battery-driven operation, at least on Ericsson's unit (GRiD Systems claims an hour of battery life for its plasma-screened GRiDCase 3). Not to worry though, argues Ericsson: Most portable users don't really require battery operation anyway, and would gladly prefer a screen that's easy on the eyes to occasional battery use.

Like the K2000, Ericsson's Portable PC will run virtually all off-the-shelf programs written for the IBM PC. Unlike the K2000, though, Ericsson has opted not to use 3½-inch disks, even though the smaller microfloppy drives are more rugged, consume less power, have twice the storage of 5¼-inch drives and use easily pocketable hard-shell disks.

Until 3½-inch drives become the standard, Ericsson says it will stay with regular 5¼-inch disk drives for the convenience of software exchangeability. The company supplements its single on-board 360K drive with an optional Ergo-Disk electronic disk drive that uses some of the computer's RAM for temporary (power on) data storage. For more data capacity, Ericsson plans to offer a battery-powered backup for the Ergo-Disk RAM drive, or to incorporate a hard-disk drive in the unit—possibly by the time you read this.

The Ericsson Portable PC features a detachable keyboard that more closely resembles IBM's configuration than Kaypro does. Moreover, Ericsson transposes some of the more problematically placed keys on the IBM's board, and shifts the function keys from the left side to the top. Keyboard action is fast and positive. Price for the base model is \$2995. The Ergo-Disk adds 256K for \$800; an outdoor disk drive is \$450. On the way for \$300 is a 300/1200-baud acoustic coupler modem—like the GP display, another instance of Ericsson traveling its own design path. The company contends this outboard will be more usable on the road than the direct-connect modem most portables favor.

new Pivot II portable is a Trans Am, born in the U.S.A. and with a no-nonsense way about it. The same machine, with a slightly different display, is also sold by TV giant Zenith as its Model Z-171.

This miniature IBM PC is a straightforward machine that offers utility without aspiring to major breakthroughs, or deviating from current standards. The 14-pound computing unit is aimed at desktop rather than laptop use, and has a rather odd lunch-pail-like shape and Darth Vader-like matte black surface.

Inside, the Pivot II provides two built-in 360K 5¼-inch disk drives, and a 10 by 5-inch LCD which, thanks to being backlit by an electroluminescent panel, is far more readable than a standard LCD. Accordingly, the Pivot II gets a modest but usable three hours of battery life on a charge.

Like the K2000, the Pivot II uses a smaller keyboard than the IBM PC and asks some keys to perform double duty. Keyboard feel is reasonably good. Unlike the Kaypro's keyboard, however, the Pivot's isn't detachable.

The Pivot II's price is \$2700 for the 256K-RAM version with two disk drives, onboard 300/1200-baud modem, built-in NiCad rechargeable battery, and a video-outboard that permits the computer unit to hook up to an external RGB or composite monitor. An upgrade to 640K of RAM is available for another \$800.

Conclusion

Which of these machines should you choose? If you need the highest possible quality display and don't absolutely require battery operation, the Ericsson with its gas-plasma screen would be a sensible choice. But, pricewise, the machine exacts a hefty premium for its lighter weight compared to full-featured IBM PC-compatible transportables such as the Compaq.

Where carrying ease is paramount and you're willing to sacrifice display legibility for longer battery life, the Kaypro 2000 should prove to be a highly useful machine—provided you aren't daunted by the process of having to transfer data or programs from one type of disk drive to another.

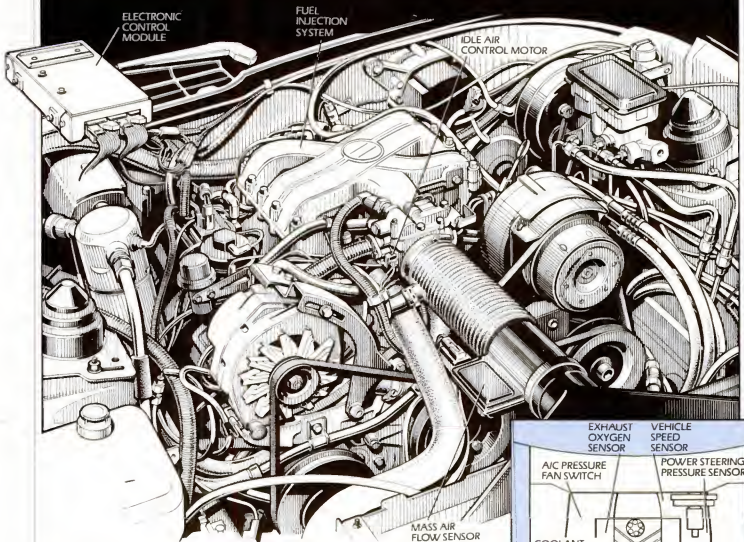
For the portable fancier who wants a full-function portable that offers ready software compatibility, the advantage of two built-in disk drives, a more viewable screen than typical of LCDs and battery life sufficient for at least a mid-range airline hop, Morrow's Pivot II and Zenith's Z-171 may well have the superior all-around answer in today's portable market.

PM

Morrow Pivot II/Zenith Z-171

If Kaypro is selling a Porsche and Ericsson a Mercedes, then Morrow's

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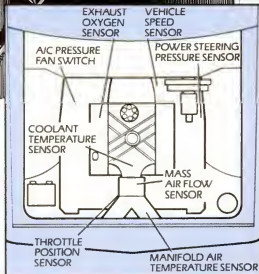


Computer engine control systems regulate automatic transmission, emissions controls plus ignition and fuel requirements based on inputs from engine and accessory-mounted sensors.

BY PAUL STENQUIST

Every time your late-model GM car starts immediately, idles smoothly or accelerates without a hitch, thank its microprocessor computer. GM's computerized engine con-

trols, from the Delco electronics division, are among the most advanced in the industry. Introduced in 1981, the GM system gathers information from a variety of sensors (see drawing above). Then the computer, or electronic control module (ECM), located under the



dash analyzes the information and regulates various important engine functions. These may include fuel mixture, spark timing, exhaust gas recirculation (EGR), canister purge, torque converter clutch application, idle speed and air injection.

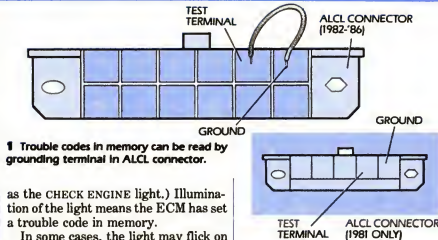
The sensors that give the ECM the information it needs can include devices that measure manifold absolute pressure or barometric and manifold pressure, throttle position, engine speed and crank position, engine knock and engine coolant temperature.

All of the systems have built-in diagnostic capability. When a problem occurs, the computer sets a trouble code. This code is stored in memory and narrows down the system fault to one area. On the systems produced since late 1980, initial troubleshooting procedures are quite simple. In the following sections, we'll explain how to check the computer system. This doesn't apply to those 1980 systems called C-4 or to earlier computer systems used on some GM cars sold in California.

A particularly advanced version of the computerized engine control system is used on the Cadillac 4.1-liter engine. In addition to far more extensive diagnostics, the Caddy electronics provide a dashboard video panel display of trouble codes. To troubleshoot the Cadillac version, you'll need a factory service manual.

Diagnostic overview

C3 diagnosis is necessary any time the CHECK ENGINE or SERVICE ENGINE SOON light, located on the dash, remains on or comes on after the vehicle has started. (We'll refer to both of these



1 Trouble codes in memory can be read by grounding terminal in ALCL connector.

as the CHECK ENGINE light.) Illumination of the light means the ECM has set a trouble code in memory.

In some cases, the light may flick on briefly due to temporary glitches caused by severe outside electronic interference. If you're not experiencing driveability problems, ignore sporadic momentary flickers of the light. But make sure you check out the computer system immediately if the light remains on for more than a second or two, or if driveability problems persist.

We have to stress that a driveability problem, such as hesitation, misfire, poor fuel economy or any other engine performance fault, is reason to check the computer system. The diagnostic light doesn't have to be illuminated.

GM divides C3 diagnosis into three basic steps. In step one, the technician finds out if the on-vehicle diagnostics are working by performing the diagnostic circuit check. If the diagnostics aren't working, this directs him to a procedure for correcting the system.

Step two involves the reading of trouble codes. If the system has stored a code, a specific procedure must be followed to find the problem.

If no trouble code is stored but a driveability problem persists, step three, known as the "System Performance Check" for carbureted cars or the "Field Service Mode" for fuel-injected cars, determines if the computer is in control of the fuel system.

Diagnostic circuit check

The diagnostic circuit check lets you know if the CHECK ENGINE light is working and if the ECM is in good shape and capable of recognizing a fault. If the car passes both of the above tests, the check will let you know if any trouble codes are stored. Armed with this information, the right troubleshooting charts and some ordinary tools, you can then find and fix the offending part. When working on C3 or any other electronic system, make sure the ignition is turned off.

You'll find the troubleshooting charts—one for each trouble code—in your vehicle service manual. If you don't have the manufacturer's service manual for your car and it's at least a year old, use one of the professional editions of the general service manuals.

Before beginning the diagnostic circuit check, securely block the driving wheels and apply the parking brake. Then turn the key to ON without starting the engine to see if the CHECK ENGINE light switches on. If it doesn't, refer to the shop manual chart that covers troubleshooting of the light.

If the light switches on, ground the test terminal of the diagnostic connector, which you'll find under the dashboard. On all except the earliest C3 systems, this connector has two rows of six terminals each (see Fig. 1). To ground the test terminal, the last two terminals of the first row are joined with a short jumper wire.

Grounding the test terminal should cause the light to turn off, then flash on,

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- Barometric Pressure (BARO)
- Differential Pressure (Vac.)

ELECTRONIC CONTROL MODULE (ECM)

SYSTEMS CONTROLLED*

- Air Management
- Canister Purge
- Exhaust Gas Recirc. (EGR)
- Electronic Spark Timing (EST)
- Fuel Control
- Idle Air Control (IAC)
- Transmission Converter Clutch (TCC) or Shift Light
- Electric Fuel Pump
- Air Conditioning
- Engine Cooling Fan
- Diagnostics
 - CHECK ENGINE Light
 - Diagnostic Test Terminal (ALCL)
 - Data Output (ALCL)
 - Electronic Spark Control (ESC)
 - Idle Speed (ISC, ILC, ISS)
 - Early Fuel Evaporation (EFE)

*Not all systems used on all engines.

turn off, and flash twice in succession. This—one flash followed by two—is Code 12, and it confirms that the diagnostic system is working.

If the diagnostic system has identified a trouble area, another code will follow Code 12. The codes are read by counting how many times the light flashes. For example, four flashes followed by a pause then five flashes, indicates a Code 45. The Trouble Code Identification chart shows that Code 45 indicates exhaust fumes are fuel rich.

If other codes are present, they will be identified in the same way. Record all codes other than the Code 12.

Carbureted engines

After recording all trouble codes, clear the memory by turning off the ignition and remove the ECM fuse from the fuse block for at least 10 seconds. Reinstall the fuse, remove the test ground and start the engine. Drive the car for at least 10 minutes.

When you return home, turn off the engine, turn the key to ON and reconnect the test terminal to ground. If previously noted trouble codes reappear, the designated troubleshooting chart must be used to track down the offending component. If the codes you wrote down earlier don't reappear, they are intermittent problems. To handle these problems, see the section of this article headlined "Intermittent Problems—Carbureted."

Fuel-Injected engines

If trouble codes were revealed in the diagnostic circuit check, follow the procedure on the applicable troubleshooting chart in the service manual. If more than one code is stored, begin with the lowest code numerically.

Troubleshooting charts

A few special tools are needed to track down the cause of any particular hard failure trouble code. Because the diagnosis of some circuits requires accurate low-voltage readings and because some circuits have a very high resistance in the ECM a digital voltmeter with a 10-megohm input impedance is needed. An ohmmeter is also needed. Other tools that might be required include a conventional unpowered test light, hand vacuum pump, tachometer and dwell meter (shown on page 152).

The troubleshooting charts in the GM manuals are arranged in "trees." After completing one step in the procedure, you simply follow the branching lines of the troubleshooting chart.

Most troubleshooting trees are ar-

ranged to eliminate all other possibilities before condemning the ECM. The ECM is a high-priced item, and you must be absolutely certain everything else is okay before replacing it.

Field service mode—fuel injected

If no trouble codes were recorded in the computer memory of a fuel-injected engine, enter the Field Service Mode by running the engine with the diagnostic terminal grounded (as it was for the Diagnostic Circuit Check). The engine should be at normal operating temperature, and you should run it at 1200 to 1600 rpm for one minute.

Note the CHECK ENGINE light. If it flashes at a rate of one flash per second, the fuel system is operating normally. If driveability problems persist, the problem is in another of the engine's systems and normal troubleshooting procedures should be applied.

If the CHECK ENGINE light flashes 2.5 times per second, the engine is in open loop mode (no computer control), and the troubleshooting chart for a Code 13

must be consulted. If the light is off all or most of the time, a lean exhaust condition is present. Go to the Code 44 chart. If the light is on all or most of the time, the exhaust gases are rich and the Code 45 chart must be used.

If you get a normal response in Field Service Mode (one flash per second), drive the vehicle at any steady speed, with the engine running in the Field Service Mode, to see if results are the same. This can help in diagnosing problems where the fuel-injection system intermittently goes into a lean or rich condition. After the Field Service Mode checks have been completed, clear the trouble codes by removing the ECM fuse, reenter the Field Service Mode by running the engine with the diagnostic terminal grounded and confirm closed-loop operation as above. Upon exiting the Field Service Mode, the engine should operate without the CHECK ENGINE light coming on.

System performance check—carbureted

If no trouble codes are recorded on a

TROUBLE CODE IDENTIFICATION

The "CHECK ENGINE" light will only be "ON" if the malfunction exists under the conditions listed below. If the light comes on or when the problem occurs. If the malfunction clears, the light will go out and a trouble code will be set in the ECM. Code 12 does not store in memory. If the light comes on intermittently, but no code is stored, perform a regular diagnostic routine. Any codes stored will be erased if no problem reoccurs within 50 engine starts. A specific engine may not use all available codes.

The trouble codes indicate problems as follows:

TROUBLE CODE 12

No distributor reference pulses to the ECM. This code is not stored in memory and will only flash while the fault is present. Normal code with ignition on, engine not running.

TROUBLE CODE 13

Oxygen Sensor Circuit—The engine must run up to four minutes at part throttle, under road load, before this code will set.

TROUBLE CODE 14

Shorted coolant sensor circuit—The engine must run two minutes before this code will set.

TROUBLE CODE 15

Open coolant sensor circuit—The engine must run five minutes before this code will set.

TROUBLE CODE 21

Throttle Position Sensor (TPS) circuit voltage high (open circuit or misadjusted TPS). The engine must run 10 seconds, at specified curb idle speed, before this code will set.

TROUBLE CODE 22

Throttle Position Sensor (TPS) circuit voltage low (grounded

circuit or misadjusted TPS).

Engine must run 20 seconds at specified curb idle speed to set code.

TROUBLE CODE 23

MIC solenoid circuit open or grounded.

TROUBLE CODE 24

Vehicle speed sensor (VSS) circuit—The vehicle must operate up to two minutes, at road speed, before this code will set.

TROUBLE CODE 32

Barometric pressure sensor (BARO) circuit low.

TROUBLE CODE 34

Vacuum sensor or Manifold Absolute Pressure (MAP) circuit—The engine must run up to two minutes, at specified curb idle before this code will set.

TROUBLE CODE 35

Idle speed control (ISC) switch circuit shorted. (Up to 70% TPS for over 5 seconds.)

TROUBLE CODE 41

No distributor reference pulses to the ECM at specified engine vacuum. This code will store in memory.

TROUBLE CODE 42

Electronic spark timing (EST) bypass circuit or EST circuit grounded or open.

TROUBLE CODE 43

Electronic Spark Control (ESC) retard signal for too long a time; causes retard in EST signal.

TROUBLE CODE 44

Lean exhaust indication—The engine must run two minutes, in closed loop and at part throttle, before this code will set.

TROUBLE CODE 45

Rich exhaust indication—The engine must run two minutes, in closed loop and at part throttle, before this code will set.

TROUBLE CODE 51

Faulty or improperly installed calibration unit (PROM). It takes up to 30 seconds before this code will set.

TROUBLE CODE 53

Exhaust Gas Recirculation (EGR) valve vacuum sensor has seen improper EGR vacuum.

TROUBLE CODE 54

Shorted MIC solenoid circuit and/or faulty ECM.

NAVAL AVIATION

(Continued from page 89)

War II. The Japanese had destroyed the U.S. Fleet in Pearl Harbor, leaving America almost weaponless in the Pacific. But the airplanes were ready.

Volumes have been written about the exploits of Navy and Marine Corps aviators during World War II. But one battle emerges as the day in the sun for naval aviation—Midway. Called the turning point of the war for America, Midway saw the Navy's Dauntless Dive Bombers work over a beleaguered Japanese fleet. Catalina flying boats, carrying the Black Cat Squadron insignia, patrolled the sea at night and dropped bombs on defenseless Japanese warships. The increasingly reliable carriers were providing the Pacific Theater with a punch that would not have been thought possible following the Day of Infamy. Among the greatest advances were the jet-assisted takeoff, giving speed and power to Martin PBM Mariner patrol planes, and new navigation systems making possible dogfighting capabilities never before available.

In 1946, in a desire to both show off and develop its newest navigation and flying equipment, the Navy established the Blue Angels. The flight demonstration team used F6F Hellcats, then switched to the more maneuverable F8F Bearcats. They wouldn't go to jet aircraft until the next decade.

Combat aviation

As a new war broke out over Korea at the turn of 1950, naval aviation was again called upon to demonstrate its power. By now the Air Force was in charge of strategic bombing and the Army was flying rescue and spy missions. The Navy was beginning to flex a new muscle: jet aircraft. The brand new twin-engine McDonnell F2H Banshee was introduced by Navy pilots over Korea. Another jet that got its first combat test with Navy men at the stick was the Grumman F9F Panther. Naturally, many new altitude and speed records were established during this period, but the most impressive record set by naval aviation in Korea was marked with the arrival of the USS *Boxer* in Yokosuka, Japan, on July 23, 1950. The ship carried 170 planes of the Navy and Air Force from California in a record eight days and 16 hours.

Korea also saw the first major uses of helicopters. Navy helicopters delivered supplies to shore batteries and did occasional rescue and patrol duty. These were the forerunners of the Vietnam era choppers. In Vietnam, the Army used the rotorcraft at first to deliver troops and later as weapons in search and destroy missions. The Navy and Marines used choppers to haul supplies

and provide air support for gunboats heading up the Mekong River.

UH-1B gun-choppers led the way as patrol boats steamed through the enemy's territory in three's and six's. Entire wings of H-4 Super Stallions housed in guns and troops for the Marines.

Meanwhile, the F-14 Tom Cat and the F-4J Phantom jets were going through their baptism of fire over Vietnam. Navy and Marine pilots were becoming extremely proficient at drawing enemy MIGs offshore and engaging them in brief dogfights ending in the Americans' favor. From June 1965 through December 1972, Navy and Marine pilots downed 56 MIGs this way.

During the years that Indochina was simmering, Navy aviators were also taking part in a bold new era of flying higher than ever. They were on the leading edge of the space program.

On Feb. 20, 1962, Marine Col. John Glenn became the first American to go into orbit in the Friendship 7 capsule. Glenn had been preceded by Cmdr. Alan B. Shepard, who became the first American in space on May 5, 1961. His space capsule, called Freedom 7, was launched 116 miles high. It traveled 302 miles downrange from Cape Canaveral and was recovered at sea. In the ensuing years, Navy pilots would dominate the space program.

New craft

As recently as last year, the Navy still had a major role in the space program. Navy pilot Bruce McCandless became the first man to travel in space in a rocket chair, called the Manned Maneuvering Unit.

Back on Earth, the Navy has in recent years been at the forefront of combat experimental aviation. In the 1980s, the Navy and Marines have been working on a range of new aircraft, including the Harrier jump jets, the F-18 fighters with high speed and maneuverability, the redesigned P-3 Orion with its advanced Harpoon Missile system and the tilt-rotor VX-15, built by Bell Textron. The tilt-rotor craft will soon give the Navy America's first combat-ready vehicle that can operate either as a fixed-wing or rotor craft.

At sea, over land and lately in space, the naval aviator is assigned to provide defensive services and perform experimental flights. There is no telling how far the Navy is going to go over the next 75 years. But in one NASA report on the future possibilities of travel to Mars, the writer says: "The vehicles will approach the planet like a fleet of naval vessels with the flagship hovering in orbit and the attack squadrons spreading out to do their various exploratory jobs."

The next sea appears endless for naval aviation.



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A rollabout TV/VCR center can make viewing a pleasure.

This easy-to-build stand is designed to accommodate a television on the upper shelf and a video cassette recorder on the lower shelf. The stand is built of solid red oak, except for the two shelves, which are $\frac{1}{2}$ -in. oak-veneer plywood. The stand is dimensioned to hold a 19-in. diagonal television. However, the size can be altered easily for your TV and video equipment.

Cut all the parts to size as given in the materials list. Cut a $\frac{1}{4} \times \frac{1}{4}$ -in. notch in each corner of the shelves using a saber saw or backsaw. Also, bore a $\frac{3}{16}$ -in.-dia. lagscrew clearance hole through each corner block. Now, before assembling the parts, ease the sharp edges of all the hardwood parts with 120-grit abrasive paper. Next, assemble the top shelf, cleats, corner blocks and rails as a single unit. First, glue and nail the 1×1 -in. cleats to the rails using 4d finishing nails. Then, glue the corner blocks and the top shelf to the rails. Clamp the assembly square and set it aside until the glue dries. Assemble the lower shelf, cleats, corner blocks and rails in the same manner as described for the top shelf.

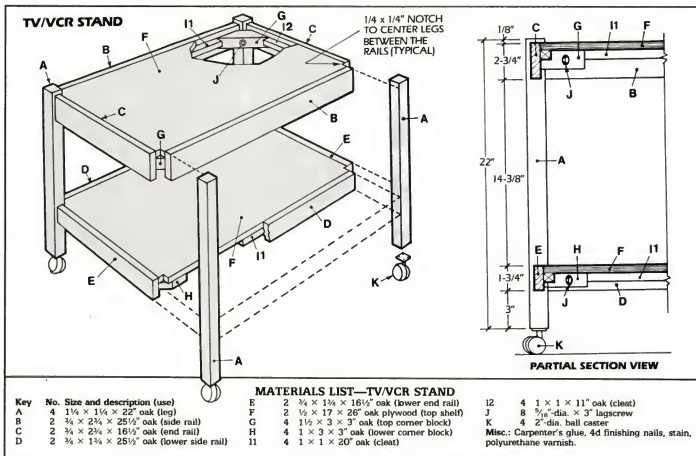
Using a diagonal (45°) clamping fixture or doweling jig to hold the legs at the proper angle, bore two $\frac{3}{16}$ -in.-dia. lagscrew pilot holes in each leg. Position the holes so that the legs extend $\frac{1}{4}$ in. above the upper rails. Fasten each leg in place with two $\frac{5}{16}$ -in.-dia. $\times 3$ -in. lagscrews. Don't apply glue to the legs. This way, the stand can be disassembled



Oak stand is designed to hold a full-size television and video recorder.

and transported easily. Now finish-sand the entire piece with 220-grit abrasive paper. Wipe away the sanding dust with a tack cloth and then apply a coat of stain, if desired. Once the stain has dried thoroughly, you should apply two coats of polyurethane varnish. Sand between coats with 4/0 steel wool. Finally, attach a 2-in.-dia. ball caster to each leg and you're ready to install the television and VCR.

—Leonard Heiferting





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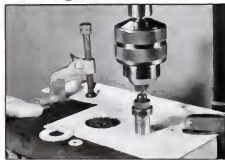
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HINTS FROM READERS

Making washers



The chucked hole saw has an outside diameter that's suited to washer's center hole.



With the center hole cut, use a larger hole saw to cut the washer's outside diameter.

Many times odd-size washers are needed in home repairs and in shop projects. Often the desired sizes, especially the larger and thinner washers, are hard to find in stores.

With a nest of hole saws, however, you can make large washers or rings in your workshop from materials such as sheet aluminum, brass, plywood, or any other material that the saws will neatly cut.

First select a saw that has an outside diameter that is the same as the size desired for the diameter of the center hole. Then adjust the pilot drill to project about 1/4 in. Clamp the washer material firmly to the drill-press table and cut the hole.

Without moving the workpiece, you should remove the small hole saw and install a larger one whose inside diameter forms the desired washer outside diameter. Finally, remove any burrs with a file or an abrasive tool and you have a custom washer.—Walter E. Burton

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BY JACK AND ELLEN MESSMER

The control tower at Andrews Air Force Base outside Washington buzzes with takeoffs and landings 24 hours a day. The planes carry generals, admirals, senators and ambassadors. The tower is always charged with excitement. But when the voice on the other end of the communications system announces "This is Air Force One," everything stops. The room grows quiet. All other traffic gets standby status. The plane that is calling the tower carries the president of the United States.

Since the days of Teddy Roosevelt, American presidents have flown, at first just around the East Coast, and more recently all over the world. The aircraft and the crews that man them are special.

"The man who flies me around had better have his head-set on straight," said Lyndon Johnson of his Air Force One staff. Johnson was sworn into office aboard Air Force One following John F. Kennedy's murder in Texas. The swearing-in symbolized a new era for the presidency.

Presidents just didn't travel much until America was over 150 years old. Before World War II, only two U.S. presidents had left the country while in office: Teddy Roosevelt made one quick boat trip to Panama and Woodrow Wilson journeyed to Europe after World War I ended, evoking considerable criticism on the home front for the extended cruise to the Paris Peace Conference that took him away from Washington for so long.

It took the next World War to make long-distance presidential trips a necessity. And by that time a much



Air Force One waits on runway (top). Inside, President Reagan enjoys a light moment with his crew. Reagan has two planes.

faster means of travel was gaining acceptance—the airplane. F.D.R. had flown from New York to Chicago in 1932 to deliver his acceptance speech to the Democratic National Convention. But he remained earthbound for the first 10 years of his presidency.

Planning for Franklin Roosevelt's hopscotch flight to Casablanca in northern Africa—through air space that was still a war zone—was on a "need to know" basis. It was only after F.D.R. had met with British Prime Minister Winston Churchill and Allied commanders, to plan the D-Day assault, that the American public (and the rest of the world) learned of the historic first overseas flight by a president.

Roosevelt's trip in January 1943 had not been by military plane, but rather by commercial aircraft and crewmen pressed into wartime service. A Pan Am Boeing 314

(Please turn to page 160)

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The next Air Force One is expected to be a DC-10 [right]. Jimmy Carter held many staff conferences aboard his Air Force One jet [below left]. Lyndon Johnson was sworn in aboard John F. Kennedy's Air Force One as Kennedy's body was transported home.



WIDE WORLD PHOTOS

PRESIDENTIAL PLANES (Continued from page 158)

"Flying Boat" (which required water, instead of a runway, for takeoff and landing) handled the transatlantic portions of the trip between Miami and the western coast of Africa and a Trans World Airlines C-54 (with landing gear) provided F.D.R. with transport on the African continent.

With an airborne president in the White House, the Army Air Corps set out to claim its rightful place as air chauffeur to the Commander in Chief. And before the year was out it had in its fleet a plane believed suitable for presidential travel. But the Secret Service got the White House to use a TWA plane for the President's air travel to secret conferences in Iran and Egypt with Churchill and the Soviet Union's Marshal Josef Stalin.

The Army C-87, a passenger version of the B-24 bomber, flew many VIP missions, including trips by First Lady Eleanor Roosevelt. But the plane, which had been nicknamed the *Guess Where II* by its pilot, never did carry F.D.R. or any of his successors.

There may also have been a predecessor to the *Guess Where II*—another "presidential" plane that never carried a president. In the 1930s, the Naval Air Station Anacostia in southeast Washington, D.C., kept on hand a Douglas Dolphin Seaplane RD-2 to provide "special" services to the president, such as ferrying White House mail and special guests to the presidential yacht. F.D.R. never flew in it.

F.D.R. did, however, fly in a "presi-

dential" plane on one trip before his death. The craft was a Douglas C-54 Skymaster—the military version of the DC-4. Dubbed the *Sacred Cow* by the press (much to the chagrin of Air Corps and White House officials), the plane was the first of the succession of aircraft to be viewed by the public as "the president's plane."

Harry Truman, unlike F.D.R., liked flying and used the *Sacred Cow* often. And by the summer of 1947, the presidential plane was upgraded to a state-of-the-art, radar-equipped, long-range craft. American Airlines agreed to let the Air Force lay claim to one of the DC-6s Douglas Aircraft already had on its production line for the commercial carrier. Before the irreverent White House press corps got a shot at this aircraft, *Sacred Cow* pilot Lt. Col. Henry Myers saw to it that his new charge was dubbed

Independence, after the President's Missouri hometown and because the plane was commissioned on Independence Day—1947.

The advanced plane had many advantages over the DC-4. The *Independence* was the first DC-6 equipped with a weather radar system in its nose capable of detecting storms or turbulence within 30 miles. It also carried a radio teletype system that could transmit and receive messages over 3000 miles so Truman did not have to be out of touch with Washington.

In the early days of presidential fly-
(Please turn to page 162)



The Lockheed Columbine was Dwight Eisenhower's Air Force One.

PHOTO FROM U.S. AIR FORCE/ENHOWER LIBRARY

Dear Friend,

My name is John Wright. Not too long ago I was flat broke. I was \$31,000 in debt. The bank repossessed my car because I couldn't keep up the payments. And one day the landlord gave me an eviction notice because I hadn't paid the rent for three months. So we had to move out. My family and I stayed at my cousin's place for the rest of that month before I could manage to get another apartment. That was very embarrassing.

Things have changed now. I own four homes in Southern California. The one I'm living in now in Beverly Hills is worth more than one million dollars. I own several cars, among them a brand new Mercedes and a brand new Cadillac. Right now, I have a \$1 million dollar line of credit with the banks and have certificates of deposit at \$100,000 each in my bank in Beverly Hills.

Best of all, I have time to have fun. To be me. To do what I want. I work about 4 hours a day, the rest of the day. I do things that pleases me. Some days I go swimming and sailing — shopping. Other days, I play racquetball or tennis. Sometimes, frankly, I just lie out under the sun with a good book. I love to take long vacations. I just got back from a two week vacation from — Maui, Hawaii.

I'm not really trying to impress you with my wealth. All I'm trying to do here is to prove to you that if it wasn't because of that money secret I was lucky enough to find that day, I still would have been poor or may be even bankrupt. I was only through this amazing money secret that I could put myself out of debt and become wealthy. Who knows what would have happened to my family and me.

Knowing about this secret changed my life completely. It brought me wealth, happiness, and most important of all — peace of mind. This secret will change your life, too! It will give you everything you need and will solve all your money problems. Of course you don't have to take my word for it. You can try it for yourself. To see that you try this secret, I'm willing to give you \$20.00 in cash. (I'm giving my address at the bottom of this page. I figure \$20.00 is a lot. I get your attention. And you will prove it to yourself this amazing money secret will work for you, too!)

Why, you may ask, am I willing to share this secret with you? To make money? Hardly! Of course I already have all the money and possessions I'll ever need. Second, my secret does not involve any sort of competition whatsoever. Third, nothing is more satisfying to me than sharing my secret only with those who realize a golden opportunity and get on it quickly.

This secret is incredibly simple. Anyone can use it. You can get started with practically no money at all and the risk is almost zero. You don't need special training or even a high school education. It doesn't matter how young or old you are and it will work for you at home or even while you are on vacation.

Let me tell you more about this fascinating money making secret:

With this secret the money can roll in fast. In some cases you may be able to cash in literally overnight. If you can follow simple instructions you can get started in a single afternoon and it is possible to have spendable money in your hands the very next morning. In fact, this just might be the fastest legal way to make money that has ever been invented!

This is a very safe way to get extra cash. It is practically free. It is not a dangerous gamble. Everything you do has already been tested and you can get started for less money than most people spend for a night on the town.

One of the nicest things about this whole idea is that you can do it at home in your spare time. You don't need equipment or an office. It doesn't matter where you live either. You can use this secret to make money if you live in a big city or on a farm, in a suburb in between. A husband and wife team from New York used my secret, worked at home in their spare time, and made \$45,000 in one year.

This secret is simple. It would be hard to make a mistake if you tried. You don't need a college degree or even a high school education. All you need is a little common sense and the ability to follow simple, easy, step-by-step instructions. I personally know a man from New England who used this secret and made \$2 million in just 3 years.

You can use this secret to make money no matter how old or how young you may be. There is no physical labor involved and everything is so easy it can be done even if you're a teenager or 90 years old. I know one woman who is over 65 and is making all the money she needs with this secret.

Here's what newspapers and magazines are saying about this incredible secret:

The Washington Times:
The Royal Road to Riches is paved with golden tips.
Los Angeles Herald Examiner:
We've all got to start somewhere... The Royal Road to Riches is the first step in the right direction!
National Examiner:
John Wright has an excellent guide for achieving wealth in your spare time.
Income Opportunities:
The Royal Road to Riches is an invaluable guide for finding success in your own back yard.

News Tribune:
Wright's material is a MUST for anyone who contemplates making it as an independent entrepreneur.

Success!
John Wright believes in success, pure and simple.

Money Making Opportunities:
John Wright has a rare gift for helping people with no experience make loads of money. He's made many people wealthy.

Hollywood Trade Press:
We have never heard of an advertiser offering to pay readers \$20 to try its program. Wright's willingness to do this convinces us that his money secret must really work.

California Political Week:
...The politics of high finance made easy.

Hollywood Citizen News:
He does more than give general ideas. He gives people a detailed A to Z plan to make big money.

The Desert Sun:
Wright's Royal Road to Riches lives up to its title in offering an uncomplicated path to financial success.

When you use this secret to make money you never have to try to convince anybody of anything. This has nothing to do with door-to-door selling, telephone solicitation, real estate or anything else that involves personal contact.

Everything about this idea is perfectly legal and honest. You will be proud of what you are doing and you will be providing a very valuable service.

It will only take you two hours to learn how to use this secret. After that everything is almost automatic. After John got started you can probably do everything that is necessary in three hours per week.

PROOF

I know you are skeptical. That simply shows your good business sense. Well, here is proof from people who have put this amazing secret into use and have gotten all the money they ever desired. Their initials have been used in order to protect their privacy, but I have full information and the actual proof of their success in my files.

'More Money Than I Ever Dreamed'

"All I can say — your plan is great! In just 8 weeks, I took in over \$100,000. More money than I ever dreamed of making. At this rate, I honestly believe, I can make over a million dollars per year." A. F., Cranston, R.I.

'\$9,800 In 24 Hours!'

"I didn't believe it when you said the secret could produce money the next morning. Boy, was I wrong, and you were right! I purchased your Royal Road to Riches. On the basis of your advice, \$9,800 poured in, in less than 24 hours! John, your secret is incredible!" J. K., Laguna Hills, CA

'Made \$15,000 In 2 Months At 22'
"I was able to earn over \$15,000 with your plan — in just the past two months. As a 22 year old girl, I never thought that I'd ever be able to make as much money, as fast as I've been able to do. I really do wish to thank you, with all of my heart." Ms. E. L., Los Angeles, CA

'Made \$126,000 In 3 Months'
"For years, I passed up all the plans that promised to make me rich. Probably I am lucky I did — but I am even more lucky that I took the time to send for your material. It changed my whole life. Thanks to you, I made \$126,000 in 3 months." S. W., Plainfield, IN

'Made \$203,000 In 8 Months'

"I never believed those success stories... never believed I would be one of them... using your techniques, in just 8 months, I made over \$203,000... made over \$200,000 more in the last 22 days! Not just well prepared, but simple, easy, fast... John, thank you for your Royal Road to Riches!" C. M., Los Angeles, CA

'\$500,000 In Six Months'

"I'm amazed at my success! By using your secret I made \$500,000 in six months. That's more than twenty times what I've made in any single year before! I've never made so much money in such short time with minimum effort. My whole life I was waiting for this amazing miracle! Thank you, John Wright." R. S., Melean, VI

As you can tell by now I have come across something pretty good. I believe I have discovered the sweetest little money-making secret you could ever imagine. Remember — I guarantee it.

Most of the time, it takes big money to make money. This is an exception. With this secret you can start in your spare time with almost nothing. But of course, you don't have to start small or stay small. You can go as fast and as far as you wish. The size of your profits is totally up to you. I can't guarantee how much you will make with this secret but I can tell you this — so far this amazing money producing secret makes the profits from most other ideas look like peanuts all right!

Now at last, I've completely explained this remarkable secret in a special money making plan. I call it "The Royal Road to Riches". Some call it a miracle. You'll probably endorse "The Secret of Riches". You will learn everything you need to know step-by-step. So you too can put this amazing money making secret to work for you and make all the money you need.

To prove this secret will solve all your money problems, don't send me any money, instead postdate your check for a month and a half from today. I guarantee not to deposit it for 45 days. I won't cash your check for 45 days before I know for sure that you are completely satisfied with my material.

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There is no way you can lose. You either solve all your money problems with this secret (in just 30 days) or you get your money back plus \$20.00 in cash FREE!

Do you realize what this means? You can put my simple secret into use. Be able to solve all your money problems. And if for any reason whatsoever you are not 100% satisfied after using the secret for 30 days, you may return my material. And then I will not only return your original UNCASHED CHECK, but I will also send you an extra \$20.00 cashiers check just for giving the secret an honest try according to the simple instructions.

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PRESIDENTIAL PLANES

(Continued from page 160)

ing, it was a matter of pride (if not for the nation, at least for the Air Force) to have the president of the United States fly in the fastest and most modern passenger planes available. The crew of the *Sacred Cow* claimed six world records, including the first nonstop London-to-Washington flight and the first logging of over 5000 miles in a day.

If Truman liked flying, Dwight Eisenhower loved it. The retired Army General is, to date, the only licensed pilot to have served in the Oval Office. For his presidential plane, Ike was presented with a Lockheed Constellation model 749 (a C-121 to the military). Air Force brass had noted that the new Commander in Chief had developed a special liking for the model while serving in Europe, and had named his personal military craft the *Columbine*, after the state flower of his wife's home state, Colorado. The presidential plane became *Columbine II*.

Rapid advancement in aircraft technology made *Columbine II*'s stint as the president's plane a short one. In 1954 it was replaced by *Columbine III*, a Lockheed 1049C Super-Constellation.

Into the jet age

Although the propeller-driven *Columbine III* remained his official plane, Ike brought the presidency into the jet age when he went on a whirlwind tour of 11 European, African and Asian nations in 18 days in 1959. It was a schedule not possible in the Lockheed Super-Constellation.

John F. Kennedy also preferred jet travel and made little use of the Douglas VC-118A assigned by the Air Force as his first official presidential plane. The craft, a military version of the DC-6, was similar to Truman's *Independence* and Kennedy used it only for trips to airports lacking the longer runways needed for the Boeing jets.

Delivered in 1962, Kennedy's Air Force One was an improved version of the earlier Boeing 707s. It was longer and had a wider wingspan, but could land on a shorter runway than its older sisters. Also, it had a flying range of 7000 miles without refueling.

Gone was the military appearance of earlier presidential planes. Designer Raymond Loewy, assisted by First Lady Jacqueline Kennedy, created the subtle but impressive blue and white paint job still used today. Instead of "United States Air Force," the craft carried the presidential seal, American flags and the words "United States of America." Mrs. Kennedy also saw to the outfitting of the plane with amenities such as crystal glassware.

(Please turn to page 164)

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PRESIDENTIAL PLANES

(Continued from page 162)

Proudly displaying the symbols of power, the jet served Kennedy for only a bit over 13 months. It was the plane that returned his body from Dallas. The President was aboard, but it was a different president—Lyndon Baines Johnson.

But the unpopular war in Vietnam forced Johnson to give up the White House and his plane. The same jet purchased for President Kennedy was passed on to serve Richard Nixon. And although it was superseded in December 1972 by a near-twin, the jet has continued to serve as a backup Air Force One throughout the Ford, Carter and Reagan presidencies.

New generation

With the current Air Force One nearly 13 years old, and its backup approaching 23, there's been talk for several years about replacing the presidential jetliner with a new-generation aircraft. Most speculation focuses on wide-body jumbo jet models—Boeing's 747, the McDonnell Douglas DC-10 and Lockheed's L1011, although the Air Force has indicated it probably will go with the DC-10.

Somewhere aboard Air Force One is a special compartment for the "black box" containing the secret codes that could be used by the president to order military action. The communications facilities aboard the aircraft are extremely hush-hush. But in boasting of the plane's facilities, President Reagan has noted that he can place a telephone call to anywhere in the world and speak freely on a "secure" line.

The Air Force and White House wouldn't want any information made public, either, concerning any special safety devices that wouldn't be found on a standard Boeing 707. It's doubtful that President Reagan would have only his seat cushion to use for flotation should Air Force One ever have to put down in water.

There has never been a crash of a presidential plane, with or without the president aboard. But there have been a few safety incidents.

A University of Chicago meteorologist, Tetsuya Theodore Fujita, warned the Air Force that Air Force One narrowly missed being caught in a violent downdraft two years ago. Fujita was studying microbursts—strong downdrafts that cause winds to spread out in a ring-like pattern as they reach the ground. Fujita urged installation of a type of radar capable of detecting the downdrafts, but the Federal Aviation Administration doesn't expect to have one operational in the Washington area until the 1990s.

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HOLLYWOOD AT HOME

Want dazzling video movies? The latest creative tools let you add special effects, customize soundtracks and make sharp copies, too.

BY CARL CAIATI

Think of the last movie you saw. It wasn't a movie at all until the many hours of raw footage were boiled down to a smooth-flowing narrative about two hours long.

All this cutting, splicing and rearranging occurs in what Hollywood calls the post-production stage, where the soundtrack and special effects are mixed in as well. If done correctly, the seams are hidden and the rivets countersunk to give the appearance of a picture-story filmed on a single reel, shaped from a single

(Please turn to page 168)

The most basic home video studio needs two VCRs and TV monitors. Signal processing components are inserted between the VCRs.



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Editing Controller, VE582UQ by Quasar (\$190), synchronizes two VHS decks.



Sony's SL-900HF SuperBeta HiFi VCR (\$1500) has built-in editing controller for Beta decks.



JVC's Video Corrector, JX-C7 (\$350), gives total creative control.



Sansui AV-77 (above, \$350) and AV-99 (right, \$500) provide color and quality control, video/audio mixing and dubbing.

piece of material. Your videotape moves and dubbing a copy can be mastered with patience and practice. Equipment-wise, you can perform rudimentary editing on a shoestring budget with only two VCRs. To add greater sophistication to your production, there is a wide variety of electronic aids that spans a reasonable price range. What you bring to the party is the raw material—and the imagination to create something from it.

The basic techniques of editing a tape and dubbing a copy can be mastered with patience and practice. Equipment-wise, you can perform rudimentary editing on a shoestring budget with only two VCRs. To add greater sophistication to your production, there is a wide variety of electronic aids that spans a reasonable price range. What you bring to the party is the raw material—and the imagination to create something from it.

Requirements

For the most basic video dubbing and editing, you'll need one machine to play the master tape and a second to make the copy. Because the copying machine needs recording ability, only a videocassette recorder (VCR) will do. Playback is all that's required for the master tape. This means you can use a VCR, a camcorder or even a videocassette player (VCP).

You'll also need audio and video ca-

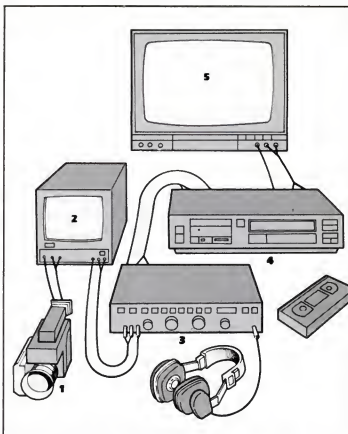


bles to route the signals from VCR to VCR. It's best to use cables with RCA-type phono plugs, since these let you transfer the signal directly from the OUT jacks of one VCR to the IN jacks of the second.

Regarding videotape, use the best grade possible for your copy (and even for the original). There's always some signal degradation when you duplicate. A high-grade or super-high-grade cassette will retain more of the original's quality. If that original was recorded on a high-quality tape, your copy will be so much the better.



V615A from Recoton (\$350) provides fades, color, sharpness control for four copies.



The ideal editing hookup: Master tape (1) in camcorder or VCR is watched on monitor (2) and fed to add-on (3) for signal processing (color correction, detail enhancement, and so on) before copying on the second VCR (4). Dub is then monitored on the second TV (5).

Two-VCR households are not yet as common as 2-car garages, but you can borrow a second machine from a friend, or lease one from the same dealers who rent videocassettes. Ideally, you should make your copy on the machine that will be used to play it. This won't be possible if you're copying a tape of junior's graduation for geographically distant relatives. In this case, play the master tape on the machine that made it. Copies, by the way, will look best if recorded at the fastest speed (Beta II or SP for VHS)—no matter what speed you used for the master copy.

Monitor your production

You'll probably want some visual confirmation of your results. This isn't necessary when simply dubbing a straight copy, but it's essential when you're editing master tapes to assemble a customized copy.

The most suitable hookup requires two TV screens—one to find your way through the master, the other to check the quality of your copy. Ideally, each display will be color (for valid comparisons) and both will be monitor/receiver models.

Monitor/receivers, unlike conventional TV sets, have audio/video input and output jacks, usually on their back panels. These jacks let you make direct

connections with the VCRs, and feed the signal through one component to the next with little or none of the deterioration that occurs with through-the-antenna connections.

For editing purposes, you'd feed the output from your master tape VCR to the IN jack of the first monitor. This original signal is then relayed to the copying deck by running cable from the monitor's OUT to the second deck's IN



Vidcraft's Detailer III (\$300) allows you to correct specific areas within an image.

jacks. You'll watch your copy on the second monitor by running the dubbing deck's output to the TV's input.

How to edit

Although there's a wide variety of accessory components that make editing easy and add special effects to your copy, it is possible to perform rudimentary editing with your VCRs alone. For the most part, the process involves skillful use of the PAUSE button on each machine.

If you were to simply use the START and STOP controls at the beginning and end of a tape segment, you'd get visible glitches and audible slurs on your copy. These glitches and slurs occur because it takes the VCR a moment or two to crank up to proper speed from a dead stop. This is minimized when you release the brake from PAUSE, because the machine's already in play. Glitching and slurring is further minimized on top-of-the-line VCRs that sport a "backspace edit" control, which literally backs the tape up to the point where you've hit PAUSE, and cues it up for the next frame.

This manual pause-editing isn't fault-free, and it's easier on some VCRs than on others. A model with single-frame



Akai SS-V20 (\$650) has 4 1/2-in. color TV, handles six sources and two TVs.

advance will help you get exactly to the right editing point. Slow-motion's helpful too.

Helpful accessories

A separate component that will home-in on editing points and synchronize two VCRs to start and stop is the VE582UQ Editing Controller from Quasar (\$190). It's designed for VHS-
(Please turn to page 170)

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HOLLYWOOD AT HOME

(Continued from page 169)

format recorders—and only those brands made by Quasar-parent Matsushita since 1982. These include General Electric, Magnavox and Panasonic. There are no Beta-format editors available to consumers, but Sony's SL-HF900 SuperBeta HiFi VCR (\$1500) has a built-in controller that will synchronize another Beta deck. For editing control over 8-mm VCRs, Sony offers the RM-E100V (\$180).

Editing controllers don't give you



Hybrid-8 special effects generator by VIP [5419] provides fades, wipes and more.

special effects, but accessory special-effects generators and signal processors (we'll call them add-ons) can be used to impart professional, studio-like touches to your editing. These, and editing controllers, receive the output from the master-tape VCR and process the signal before it's recorded on the dubbing deck. Pricewise they span extremes from \$50 (for Ambico's Super Duper) to \$1300 (for SciTech's SEG-31), but most weigh in around \$350. Although specific features will vary from model to model, add-ons generally let you:

- Maintain quality from original to copy, by allowing you to sharpen the details, vary brightness and correct the colors;
- Make smooth transitions between segments, either with black or white fades or horizontal, vertical and diagonal wipes across the screen;
- Alter colors completely, for example, to turn a day scene into a hallucinogenic dream;
- Create patterns, such as halos around filmed images, or kaleidoscopic mosaics.

Most add-ons also function as switching bays for multiple sources. This means you will be able to mix the output from two or more VCRs (or videodisc players) to dub onto yet another unit. Many, too, will allow you to perform audio dubbing.

Video editing can be a rewarding and fun-filled experience, but it's not without its learning pains. Just remember that magnetic tape is very forgiving. Unlike film, you can erase your mistakes and record over and over, with no one the wiser but you.

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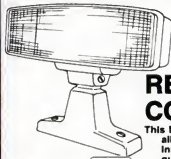
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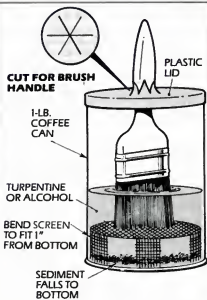
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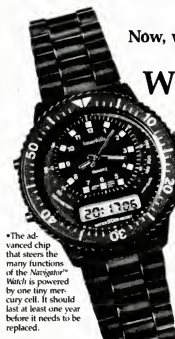
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TIME MACHINE

75 YEARS AGO: February 1911



Proposal to protect Canal.

To arm or not

The Panama Canal was within two years of completion. Lt. Gen. Nelson A. Miles, convinced it should be armed, wrote: "Prudence as well as honor, demands that we give it ample protection. Not to do so would be like building great treasury buildings and neglecting the matter of locks and bolts. At the price of American lives, we have turned the plague district of the western hemisphere into a healthful region. We have picked up the wreck of great French disaster and carried it forward with success."

Words of wisdom

Motion picture producers during the silent era forgot that there was a segment of their audience that read lips. Deaf persons were often shocked by silent dramas in which actors and actresses used unprintable language. To the deaf, who read lips with facility, the language used was as plain and distinct as speaking actors and actresses on stage is to the average theater audience. Protests were launched against the films. Films have sound now, and the protests against foul language in cinema continues.



With boots on

Famed airmen John Moisant (top) and Arch Hoxsey died in air crashes the same day. Moisant was known for his Paris-London flight. Hoxsey held an altitude record.

50 YEARS AGO: February 1936

Pass the bazooka

Saber-rattling among European countries lead to dire predictions for the next land war by inventor-engineer Hiram Percy. He foresaw the tank—or continuous-tracked vehicle, as he called it—as a major land war weapon. "We shall see on the battlefield," he wrote, "no men but thousands of tanks, battling each other as uncouth prehistoric monsters must have done, rearing and plunging, climbing and rolling over each other." The modern tank corps that nations have today pose a similar threat.



Believe it!

Robert L. Ripley's cartoon "Believe It Or Not!" had become world famous. It was read by 700,000,000, appeared in 325 newspapers and was translated into 13 languages in 38 countries. Ripley received up to 3000 letters a day from potential

contributors. His internationally syndicated cartoon spawned books, broadcasts and movies. Ripley (above) looks over one of the many oddities he defied the world to believe or not: a chicken with a 24-foot tail. Ripley's challenge lives on in TV's "Believe It Or Not!"



Metal monsters on the march.

25 YEARS AGO: February 1961

Junior racer

Got a pre-teen at home? This battery-powered small-fry hot rod would've been just the ticket. Simple and economical, it was run by a government surplus converted electric gear motor which cost about \$15 back then. It would run 10 hours on one charge and carried a 60-pound load. The battery was connected to an on-off switch. Top speed for this sidewalk sportster was no more than an animated amble. Department stores now carry children's cars with features some full-sized cars would find desirable.



Hot dog! A hot rod.



Foiling the sea

The hydrofoil was beginning to give engineers ideas. One of the first practical crafts, *Freccia del Sole* (Arrow of the Sun) entered service between Italy and Sicily. It whisked 75 passengers across the water at 45 mph.

Visions of 100-mph ocean liners and a coastal screen of 200 or 300 hydrofoil destroyers seemed only a line-drawing away. Today, hydrofoils are used worldwide as ferries and cargo boats, but the destroyer fleet hasn't come to pass.

PM

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*Calendar year 1984, Ward's Automotive Report

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